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INSTRUCTION MANUAL

MODEL

MODEL 2000/R
MULTI FUNCTION METER

NORTHEAST ELECTRONICS CORPORATION
P.O. BOX 649 - CONCORD, N. H. 03301
AREA CODE 603 224-7466

R. L. ARTMAN

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ISSUE 1

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TABLE OF CONTENTS

Section	Title	Page
1	DESCRIPTION	1-1
	1.1 Introduction	1-1
2	SPECIFICATIONS	2-1
	2.1 Introduction	2-1
3	OPERATING INSTRUCTIONS	3-1
	3.1 Introduction	3-1
4	CIRCUIT DESCRIPTION	4-1
	4.1 Introduction	4-1
	4.3 Overall Block Diagram Description	4-1
	4.5 Input Section	4-1
	4.11 Counter and Display Section	4-3
	4.18 Auto Ranging Counter Section	4-3
	4.21 Analog to Digital Converter Section	4-3
	4.23 Power Supply and Clock Section	4-5
5	MAINTENANCE AND CALIBRATION	5-1
	5.1 Introduction	5-1
	5.3 Logic Levels	5-1
	5.5 Maintenance	5-1
	5.9 Calibration	5-4
	5.11 Power Supply	5-4
	5.13 Calibration for DC Measurements	5-4
	5.15 Calibration for AC Measurements	5-5
	5.18 Calibration for DB Measurements	5-5
6	ELECTRONIC PARTS LIST	6-1
	6.1 Introduction	6-1
7	SCHEMATIC DIAGRAMS	7-1
	7.1 Introduction	7-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	Model 2000 Multifunction Meter	1-0
2-1	100mV Frequency Response Graph	2-2
2-2	1V Frequency Response Graph	2-3
2-3	10V Frequency Response Graph	2-3
3-1	Front Panel Operating Controls	3-3
4-1	Overall Block Diagram	4-2
4-2	Input Section Block Diagram	4-2
4-3	Autoranging Counter Section Block Diagram	4-4
4-4	Power Supply and Clock Section Block Diagram	4-6
5-1	Clock Output Waveform	5-1
5-2	Input Board Waveforms	5-2
5-3	Display and Counter Board Output Waveforms	5-3
6-1	Model 2000 Front Panel Assembly	6-2
6-2	Models 2000 and 2000R Input Board (PC1)	6-6
6-3	Models 2000 and 2000R Counter and Display Board (PC2)	6-10
6-4	Model 2000 Time Base and Interconnection (PC3)	6-11
6-5	Models 2000 and 2000R Power Supply and Clock Board (PC4)	6-13

LIST OF ILLUSTRATIONS (cont)

Figure	Title	Page
6-6	Models 2000 and 2000R Annunciator Assembly (PC5)	6-14
6-7	Model 2000 Power Supply Assembly	6-14
6-8	Model 2000R Front and Rear Panel Assemblies	6-15
6-9	Model 2000R Time Base (PC3)	6-16
6-10	Model 2000R Bottom Plate Assembly	6-17
7-1	Input Section Schematic	7-2
7-2	Counter and Display Schematic	7-4
7-3	Time Base and Interconnection Schematic	7-5
7-4	Power Supply and Clock Schematic	7-6

LIST OF TABLES

Table	Title	Page
2-1	Specifications	2-1
3-1	Operating Instructions	3-1
3-2	Voltage Necessary For 0 dBm	3-2
5-1	Power Supply Voltages	5-1
5-2	DC Calibration	5-4
5-3	AC Calibration	5-5
5-4	DB Calibration	5-5
6-1	List of Manufacturers	6-1
6-2	Model 2000 Overall Parts List	6-2
6-3	PC1 Assembly E95725 Parts List	6-3
6-4	PC2 Assembly E95804 Parts List	6-7
6-5	PC3 Assembly E95892 Parts List	6-11
6-6	PC4 Assembly E95748 Parts List	6-12
6-7	PC5 Assembly E95893 Parts List	6-14
6-8	Model 2000R Overall Parts List	6-15
6-9	Model 2000R PC3 Assembly E95805 Parts List	6-16

Figure 1-1. Model 2000 Multifunction Meter

SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics Corporation Model 2000 (figure 1-1) is a light weight, portable, digital multifunction meter. The Model 2000 measures ac volts, dc volts, dB and frequency. The desired measurements are selected by push-button switches and their results are displayed by four digital readout tubes. A zero pushbutton and adjustment are provided to null any offset drift for measurements of ac and dc voltages and a zero reference adjustment is provided for measurements of relative voltages in terms of dB. Normally, all measurements are auto ranging. However, a manual ranging mode is provided for frequency measurements. In this mode the decimal shift control provides decade decreases of measurement resolution begining at the maximum resolution.

1.3 The Model 2000R (figure 1-1) is the rack mounted version of the Model 2000 and the two instruments are functionally and electrically identical.

SECTION 2

SPECIFICATIONS

2.1 INTRODUCTION.

2.2 Table 2-1 and figures 2-1, 2-2, and 2-3 provide the specifications of the Models 2000 and 2000R.

Table 2-1. Specifications

AC VOLTS			
RANGES (AUTORANGING):	100 mV, 1V, 10V, 100V, 1000V		
MAXIMUM RESOLUTION:	0.1 mV		
MAXIMUM INPUT VOLTAGE:	500V peak		
ACCURACY:	±0.2% of range at 1 kHz (TA = 25° C) ±1.0% of range at 1 kHz (TA < 15° C to ≤35° C)		
FREQUENCY RESPONSE: SEE BELOW			
Range	Response		
100 mV	±0.5%	10 Hz to 100 kHz	For frequencies above 100 kHz, See figure 2-1.
1 V	±0.5%	10 Hz to 100 kHz	For frequencies above 100 kHz, See figure 2-2.
10 V	±0.5%	10 Hz to 100 kHz	For frequencies above 100 kHz, See figure 2-3.
100 V	±0.5%	10 Hz to 20 kHz	
1 kV	±0.5%	10 Hz to 20 kHz	
INPUT IMPEDANCE: 3.3M in parallel with 10 pF			
DC VOLTS			
RANGES (AUTORANGING):	100 mV, 1V, 10V, 100V, 1000V		
MAXIMUM INPUT VOLTAGE:	500V		
ACCURACY:	±0.2% (TA = 25° C) ±1.0% (15° C ≤ TA ≤ 35° C)		
INPUT IMPEDANCE:	3M		
DB			
RANGE:	+54 dB to -60 dB at 1 kHz with a 1KΩ reference (1V= 0 dB). NOTE: The upper and lower ends of the range are dependent on the reference impedance, the maximum allowable input voltage and the maximum resolution of the instrument.		

Table 2-1. Specifications (cont)

ACCURACY: (dc or 1 kHz ac 1 KΩ ref)	±0.1 dB (TA = 25° C) ±0.2 dB (15°C ≤ TA ≤ 35° C)	
FREQUENCY RESPONSE (15°C ≤ TA ≤ 35° C):	10 Hz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz	±0.2 dB ±1.0 dB ±3.0 dB
COUNTER		
RANGE (AUTORANGE):	10 Hz to 1.5 MHz	
SENSITIVITY:	10 mV rms	
RESOLUTION:	Hz Mode: 0.1 Hz kHz Mode: 1 to 1000 Hz, depending on range. Man Mode: 1 Hz or one part in 10^4 selectable to 1000 Hz, manual control.	
ACCURACY:	≥ 10 mV rms input	10 Hz to 1.5 MHz ±0.01%
POWER REQUIREMENTS	115/230 V ac ±10%	25 watts
OPERATING TEMPERATURE	15° C to 35° C	
DIMENSIONS		
Model 2000 Model 2000R	$5\frac{1}{4}$"w x 6 1/8"h x $11\frac{1}{2}$"l 19"w x $3\frac{1}{2}$"h x 11"d	
WEIGHT		
Model 2000 Model 2000R	10 pounds 10 pounds	

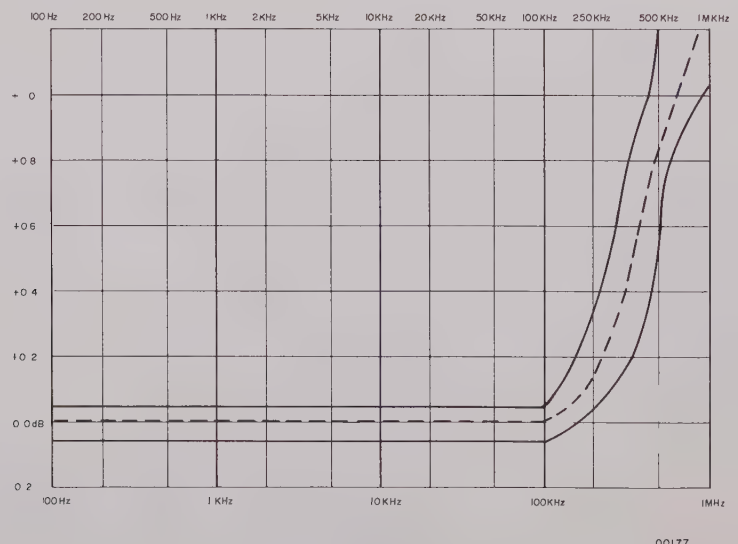


Figure 2-1. 100MV Frequency Response Graph

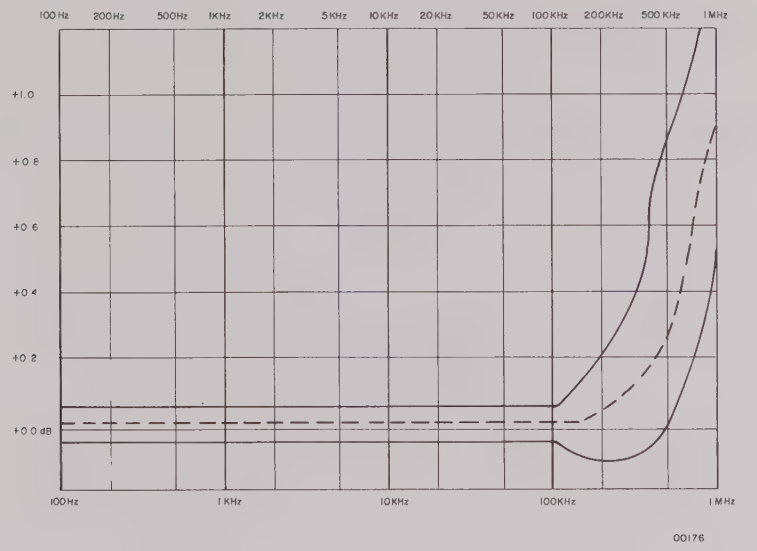


Figure 2-2. 1V Frequency Response Graph

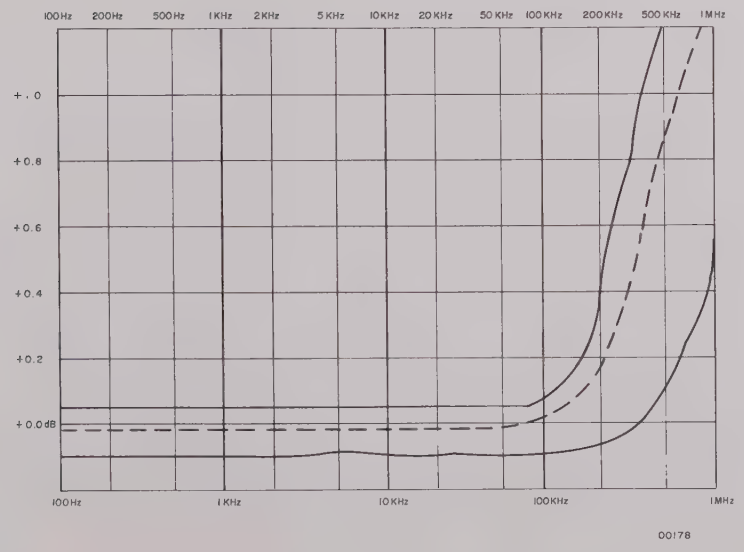


Figure 2-3. 10V Frequency Response Graph

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION.

3.2 Table 3-1 lists the function of each operating control, indicator and access point shown indexed on figure 3-1. Paragraphs 3.3 through 3.6 provide the operating instructions.

Table 3-1. Operating Instructions

Index No.	Description	Function
1	Power toggle switch	Applies the 115/230V ac line to the power supply circuitry within the test set.
2	Digital display tubes	Provide a lighted display of the measurements in numerical form.
3	VOLTMETER/COUNTER pushbuttons	Provide the selection of the measuring mode of the test set.
4	REF potentiometer	Provides an adjustable reference for dB measurements.
5	ZERO potentiometerq	Provides a zero adjustment for ac and dc voltage measurements.
6	INPUT binding	Provide access to the test set's input circuitry.
7	DECIMAL SHIFT toggle switch	Overrides the automatic ranging circuitry to provide the maximum resolution of the measurement.
8	CAL pushbutton switch	Removes input signal and allows set to be adjusted to zero millivolts.

3.3 The Model 2000, by virtue of its automatic ranging feature, requires little more than the selection of the measurement function and the connection of an input signal to provide measurements.

3.4 Power is applied to the Model 2000 by operating the power toggle switch (index no. 1, table 3-1).

3.5 Measurements are observed on the front panel display (index no. 2, table 3-1).

3.6 The selection of measuring mode is achieved by depressing one of the pushbuttons located on the front panel (index no. 3, table 3-1). The pushbuttons and the functions they provide are as follows:

a. DCV — The instrument measures dc voltages ranging from 100 mV to 600V. The range and polarity selection is automatic.

b. ACV — The instrument measures ac voltages ranging from 100 mV to 600V. The range selection is automatic. The instrument measures the average value, and displays the RMS value (sinusoidal input).

c. DB — The instrument measures voltage (ac or dc), compares the measured voltage to an

adjustable reference and displays the quantity 20 log $\frac{V\,in}{V\,ref}$ over the range of -60 dB to +60 dB (1 volt reference). For dc or sinusoidal inputs this represents relative power levels. Displays of absolute power level can then be obtained by adjusting the reference voltage to the proper level for the impedance of the circuit under test. For a 600Ω circuit, one simply provides an input voltage of 774.6 mV (measured on ac or dc voltage mode) switches to the dB mode and adjusts the reference for a 000.0 dB display. The instrument will then indicate absolute power (600Ω circuit) until the reference voltage is changed. Table 3-2 lists the voltage required for 0 dBm in a number of commonly used impedances. NOTE: To measure dB in a DC circuit, both the dB and dc pushbuttons must be depressed.

d. KHZ, HZ, MAN — The instrument measures frequency. Readings presented in the KHZ range are autoranged from a maximum resolution of I Hz to a maximum capability of 1.5 MHz. Readings presented in the Hz range have a maximum resolution of 0.1 Hz and a maximum capability of 999.9 Hz. In the MAN mode, resolution is 1 Hz and the maximum capability is manually expandable from 9,999 to 1.5 1.5 MHz in steps of one decade per operation of the DECIMAL SHIFT toggle switch. The MAN mode switch is the only push-push button; the other five buttons are of the interlocking type. The activation of MAN mode overrides all the other functions regardless of which pushbuttons have been depressed.

Table 3-2. Voltage Neccessary For 0 dBm

Impedance	mV Neccessary For 0 dBm
50	223.6
60	244.9
75	273.9
124	352.1
135	367.4
150	387.3
200	447.2
300	547.7
500	707.1
600	774.6
735	857.3
900	948.7
1000	1000

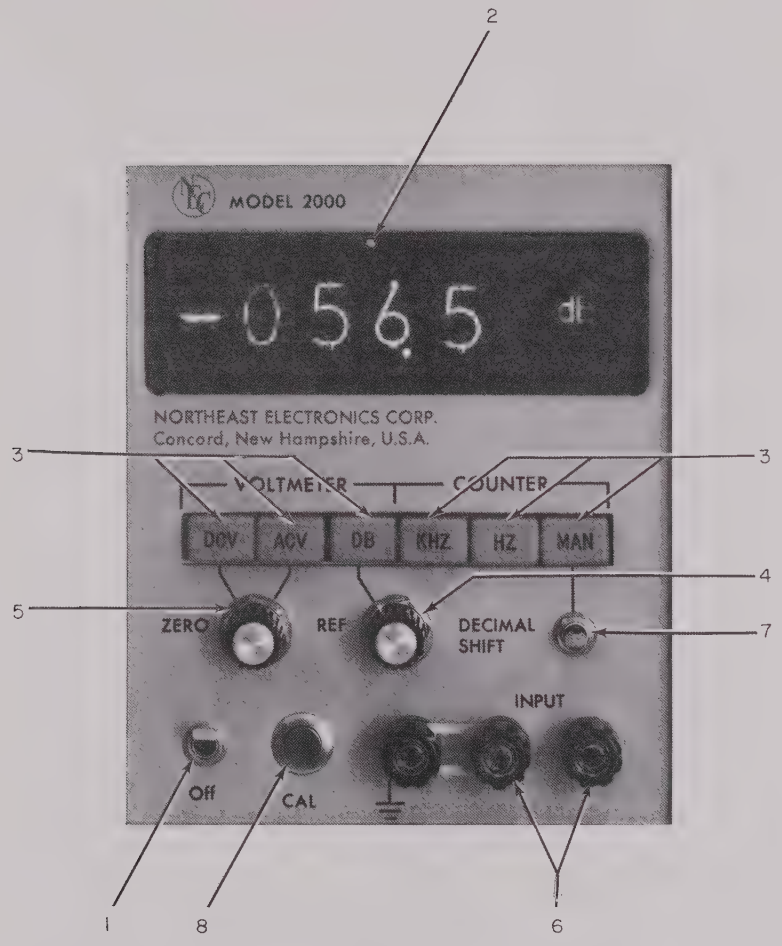


Figure 3-1. Front Panel Operating Controls

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION.

4.2 The circuit descriptions appearing in this manual are written on a functional block diagram basis. The active components contained within the functional blocks are identified by their component designators in each diagram and are easily cross-referenced to the appropraite detailed schematic in Section 7. An overall block diagram is provided first as a system introduction to the circuitory contained within the Model 2000. This is followed by more specific diagrams and descriptions that relate to the seperate functions.

4.3 OVERALL BLOCK DIAGRAM DESCRIPTION.

4.4 Referring to the overall block diagram, (figure 4-1) input signals are first connected to the input attenuator and then processed through the input amplifier which is used for both ac and dc measurements. When the instrument is used for dc measurements the output of the amplifier is connected directly to the a to d converter which provides a signal suitable for display. When the ac mode of operation is selected, the signal appearing at the output of the ac to dc converter is fed to the a to d converter. A third mode of amplitude measurement is provided when measuring ac or dc signals, that is the direct display of the signal in dB (decibels) with respect to an arbitrarily selected reference. When the mode is selected, the a to d converter is driven by the output of the log converter. Since all signals are processed by the same input attentator and amplifier, the output of the amplifier is squared by the symmetrical Schmitt circuit and provides a signal to the counter section of the instrument during frequency measurements. The time base of the instrument makes use of an internal crystal controlled oscillator and a series of driver circuits which provide several gating intervals to the auto range section of the counter that selects the proper gate for the measurement being made.

4.5 INPUT SECTION.

4.6 Referring to figure 4-2, signals appearing at the input of the Model 2000 are ac or dc coupled to the INPUT ATTENUATOR by part of the MEASURE FUNCTION SWITCHING. The net gain or loss of the INPUT ATTENUATOR and INPUT AMPLIFIER is determined by the DECODING LOGIC and the GAIN CONTROL circuits respectively. The output of the INPUT AMPLIFIER is connected to the WAVE SQUARING CIRCUIT, the AC-DC CONVERTER and, in the dc measuring mode, is switched directly to the analog to digital (a to d) converter. The WAVE SQUARING CIRCUIT converts the ac output of the INPUT AMPLIFIER to the square wave that drives the counter and display circuitry frequency measurements.

4.7 The AC-DC CONVERTER converts the ac output of the INPUT AMPLIFIER to a proportional dc voltage. This voltage is processed by the LOG CONVERTER and switched to the a to d converter during dB measurements. It is switched directly from the output of the AC-DC CONVERTER to the a to d converter during ac voltage level measurements.

4.8 The RANGING COMPARATOR provides the control function contained within the automatic level ranging loop. The RANGING COMPARATOR monitors the dc output of the AC-DC CONVERTER and instructs the REVERSIBLE COUNTER to count forward, count reverse, or stop. The count mode of the REVERSIBLE COUNTER is employed by the DECODING LOGIC in three ways ; to determine the overall gain or loss of the INPUT ATTENUATOR and INPUT AMPLIFIER, to provide output ranging for the LOG CONVERTER and to drive the DECIMAL CONTROL CIRCUIT.

4.9 The MEASURE FUNCTION SWITCHING provides input/output switching for the input section and logical commands relating to the mode of measurement for the counter and display circuitry.

4.10 The DECIMAL CONTROL LOGIC monitors the output status of the three bit REVERSIBLE COUNTER to determine the position of the decimal point on the display. Decimal information is forwarded to the counter and display circuitry.

To illustrate the operation of the auto ranging feature of the input section, assume that a dc signal is applied to the input of the instrument. The signal present at the output of the AC to DC CONVERTER will rise, moving toward a final equalibrium value. If this signal exceeds a predetermined threshold which has been set into the RANGING COMPARATOR, the comparator output will change state such that the REVERSIBLE COUNTER will count forward providing steps of attenuation (20 dB/step) until the signal at the output of the AC to DC CONVERTER drops below the threshold of the RANGING COMPARATOR. The comparator is actually a dual comparator with two threshold levels present. One threshold provides a reference signal which if exceeded, provides the upranging which we have just

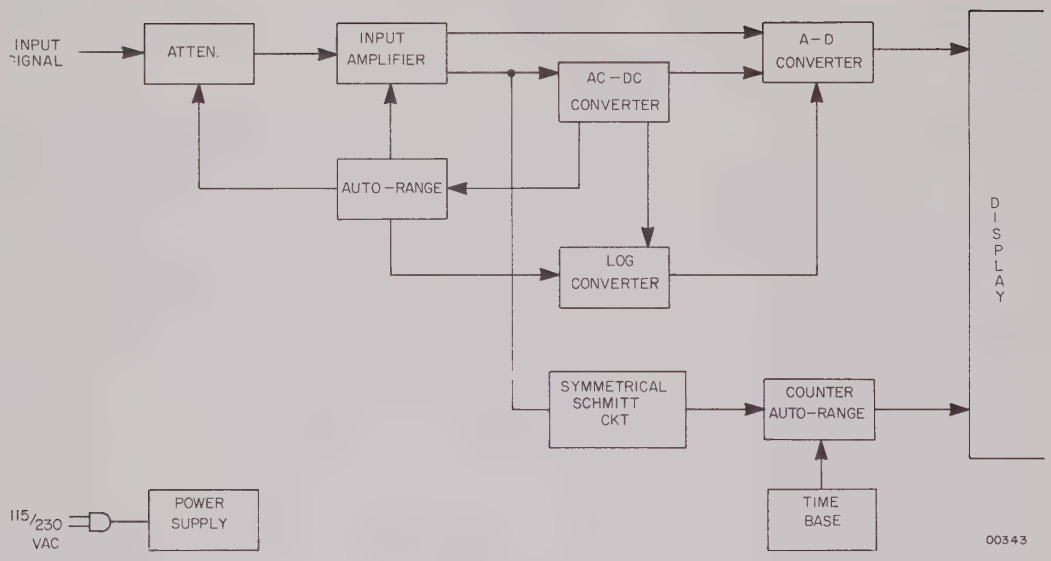


Figure 4-1. Overall Block Diagram

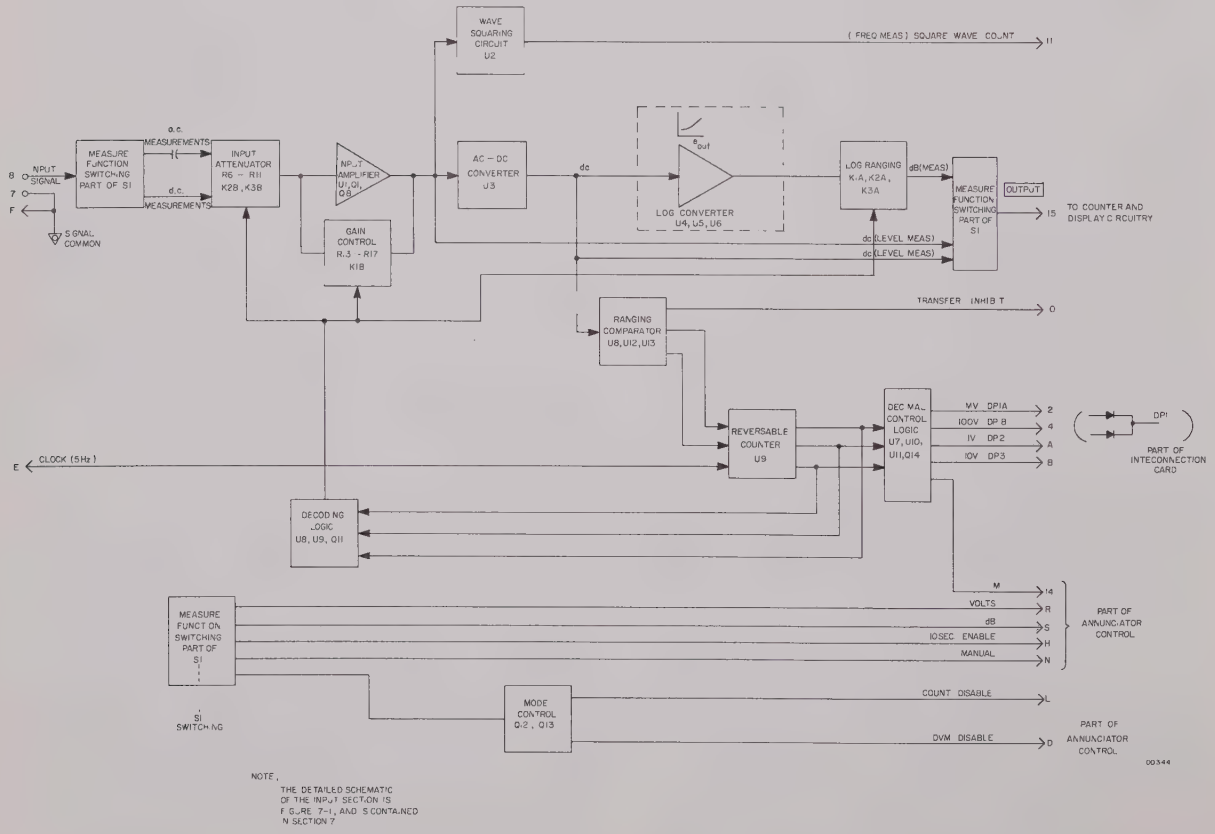


Figure 4-2. Input Section Block Diagram

described. A second threshold, somewhat less than 10% of the first, provides the necessary reference for down-ranging. If the signal at the output of the AC to DC CONVERTER drops below the lower threshold, the comparator will instruct the REVERSIBLE COUNTER to count in a reverse direction, thus providing additional gain in 20 dB steps until the voltage at the output of the AC to DC CONVERTER falls within the prescribed limits. When the AC to DC CONVERTER'S output tends toward zero, as would be the case when the input signal is removed from the instrument, the REVERSIBLE COUNTER will count down to its lowest state: that state which represents the highest gain or greatest sensitivity possible in the set. This state is detected by part of the DECIMAL CONTROL LOGIC and the REVERSIBLE COUNTER is inhibited at this point from down-ranging further.

4.11 COUNTER AND DISPLAY SECTION.

4.12 The counter and display circuitry of the Model 2000 is divided into three sections, the display section, the auto ranging counter section and the analog to digital converter section. The display section functions during all measurements, while the auto ranging counter section functions during frequency measurements (KHZ mode only) and the analog to digital converter section functions during ac, dc and dB measurements only.

4.13 DISPLAY SECTION.

4.14 The display section contains five annunciator lamps, four numeric readout tubes and one polarity readout tube.

4.15 The ANNUNCIATOR CONTROL CIRCUIT receives information relative to the type of measurement being made from the input section and drives the appropriate front panel ANNUNCIATOR LAMP to provide a visual indication of the instruments measurement status.

4.16 The COUNTER LATCHES receive BCD information from the auto ranging counter section that corresponds to the number to be displayed and, upon the reception of a transfer command, applies this information to the inputs of the DECODER DRIVERS. The DECODER DRIVERS convert the BCD information into the decimal information that drives the NUMERIC READOUT TUBES. The decimal point placement of the NUMERIC READOUT TUBES is provided by the DECIMAL DECODING LOGIC which receives decimal information from the input section in DVM modes and from the RANGING LOGIC in the counter modes.

4.17 The POLARITY CONTROL CIRCUIT monitors the output status of the COMPARATOR LATCH and drives the appropriate filament of the POLARITY READOUT TUBE to the display the polarity of the signal being measured.

4.18 AUTORANGING COUNTER SECTION.

4.19 Referring to figure 4-3, when the Model 2000 is used in the counting mode a signal is provided from the input section to the COUNT GATE. A gating signal appears from the RANGING LOGIC and gates the input signal through to the counter display circuitry for a prescribed length of time. At the beginning of the sequence the RANGING LOGIC is in its lowest state which provides the one second time base signal. If at any time during the one second interval, more than 9999 counts accumulate in the COUNTERS, a spillover signal is fed to the RANGING LOGIC incrementing it by one count. This operation selects the 100 millisecond gate and the input signal is again gated, this time for 100 milliseconds. Unless a spillover signal again occurs, at which time the RANGING LOGIC will be incremented again and the 10 millisecond gate will be selected, the accumulated count will be displayed. When one complete cycle of the selected gate occurs without spillover, the closure of the COUNT GATE at the end of the gate signal starts the TRANSFER RESET GENERATOR which transfers the accumulated count to the display section of the instrument and resets the COUNTERS. As a speed-up operation, the reset signal from the TRANSFER RESET GENERATOR also presets the time base so that only a few milliseconds are required to begin the next cycle of measurement.

4.20 The automatic ranging feature of the counter may be defeated and the instrument placed into manual operation: under these conditions the RANGING LOGIC is manually incremented by a pushbutton on the front panel of the instrument. This allows the operator to measure any signal to the maximum resolution of the instrument or to commit the counter to any specific range when measurements are to be made of signals whose frequency is known to fall within certain bounds. In order to measure signals to within 1/10 Hz, which requires a 10 second gate from the time base, there is a Hz pushbutton provided on the front panel of the instrument which commits the Model 2000 to operate with a 10 second gate.

4.21 ANALOG TO DIGITAL CONVERTER SECTION.

4.22 Referring to the block diagram (figure 4-3), the a to d converter in the Model 2000 is of the

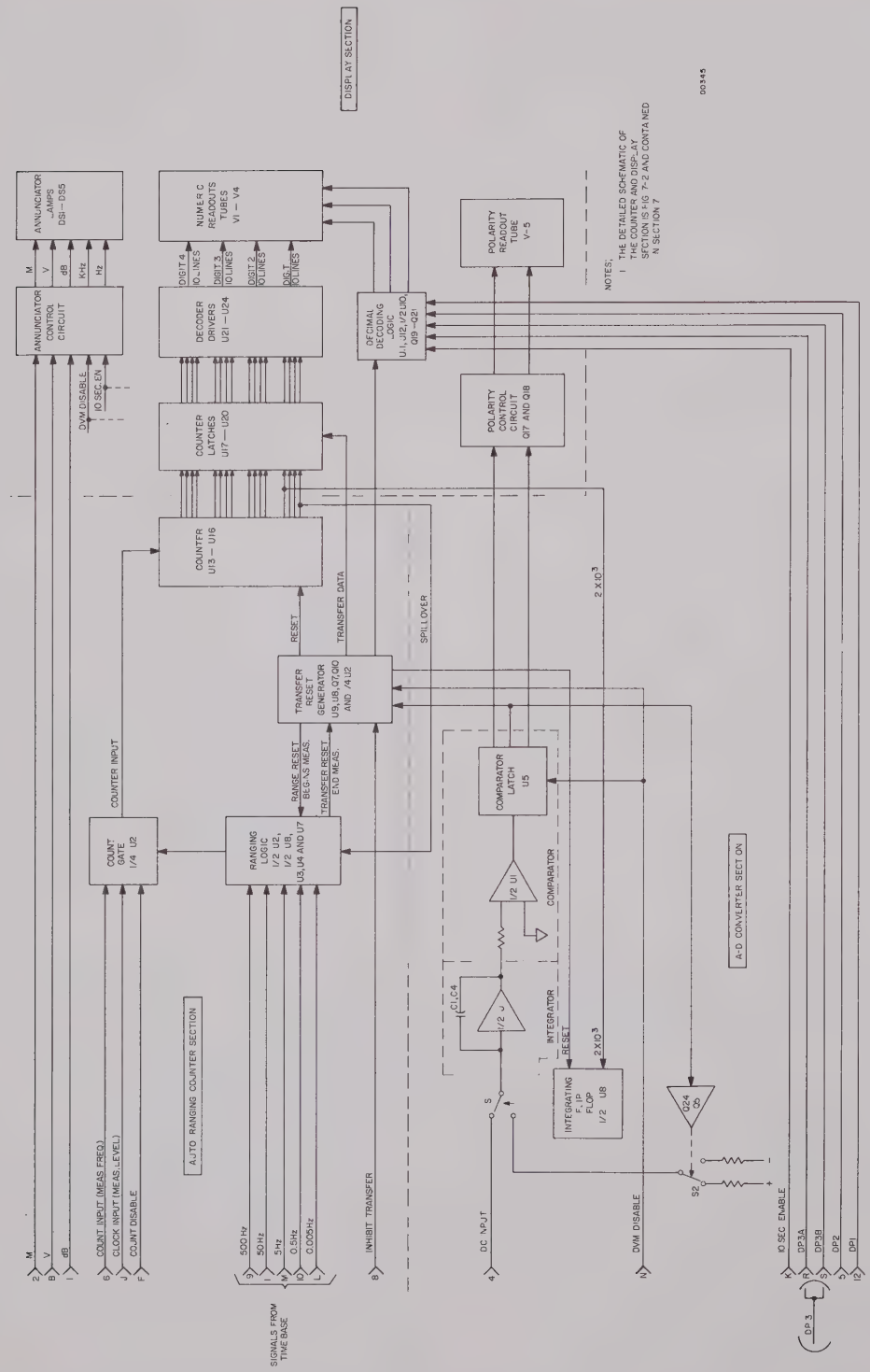


Figure 4-3. Auto Ranging Counter Section Block Diagram

dual slope integrating type. Switches S1 and S2 are shown in the diagram as mechanical, however, they are actually FET transistors used as switches. As shown in the disgram, the instrument is in the forward integrating mode. At this time, charge accumulates on the integrating capacitor for a preset time interval. This interval is precisely 2000 counts of the 5 kHz clock signal which is fed into the COUNTER. At the 2000th count, an output from the COUNTER is made available which clocks the INTEGRATING FLIP FLOP. At this time, the signal to the INTEGRATOR is provided by a precision current source, of the opposite polarity from the signal that is being measured. The charge accumulated begins to dissipate. The voltage at the output of the INTEGRATOR is reduced until it crosses 0, a condition that is detected by the COMPARATOR which is connected to the output of the INTEGRATOR. At this time all of the charge which was accumulated due to the input signal over a period of 2000 counts has been removed. The transition of the COMPARATOR'S output causes actuation of the TRANSFER RESET GENERATOR which provides two commands to the COUNTER sequentially. The first command transfers the accumulated count in the COUNTER LATCHES to the display driver section: the second command, occuring within a few microseconds after the transfer, is a reset command which resets the COUNTER to 0. At the same time, the COMPARATOR output transition resets the INTEGRATOR FLIP FLOP setting S1 to its original state and starting the measurement cycle over again. The choice of reference voltages and resistors provide the scaling factor for the display, and are selected so that the display reads directly in volts. To provide for bipolar operation, the average signal level, positive or negative, at the output of the COMPARATOR acutates the circuit that controls S2 selecting a positive or negative reference voltage depending on the polarity of the input.

4.23 POWER SUPPLY AND CLOCK SECTION.

4.24 Refering to figure 4-4, the power for the Model 2000 is derived from the 120 or 240 V ac power line. All ac voltages appearing at the inputs of the power supply and clock board are coupled through the instrument's power transformer. The function of the circuitry contained on this board is to convert these ac input voltages into the regulated and non-regulated dc voltages to operate the Model 2000, and to provide the stable 1 MHz clock signal that drives the instrument's time base circuitry.

4.25 The RECTIFIERS are full wave bridge circuits incorporating capacitive output filtering.

4.26 The +12 VOLT REGULATOR employs a zener diode reference, a high-gain differential amplifier and a series pass transistor to provide a +12 volt regulated output. This output is employed by the -12 VOLT REGULATOR and the +5 VOLT REGULATOR as a stable reference voltage, and by analog circuitry contained within the Model 2000 as a source of power.

4.27 The -12 VOLT REGULATOR employs a high-gain differential amplifier and a series pass transistor to provide a -12 volt regulated output. This output provides a source of power for analog circuitry contained within the Model 2000.

4.28 The +5 VOLT REGULATOR employs a two stage discrete amplifier and a series pass transistor to provide a +5 volt regulated output. This output provides the logic circuitry contained within the Model 2000 with a source of power.

4.29 The output of each REGULATOR circuit incorporates capacitive filtering, while the output of the 5 VOLT REGULATOR is provided with the additional feature of zener overvoltage protection.

4.30 The output of the 180 volt RECTIFIER incorporates capacitive filtering and is employed by the readout tubes located in the display section of the Model 2000 as a source of power.

4.31 The output frequency of the 1 MHz CRYSTAL OSCILLATOR is ac coupled and employed by the time base circuitry of the Model 2000 as a stable reference frequency.

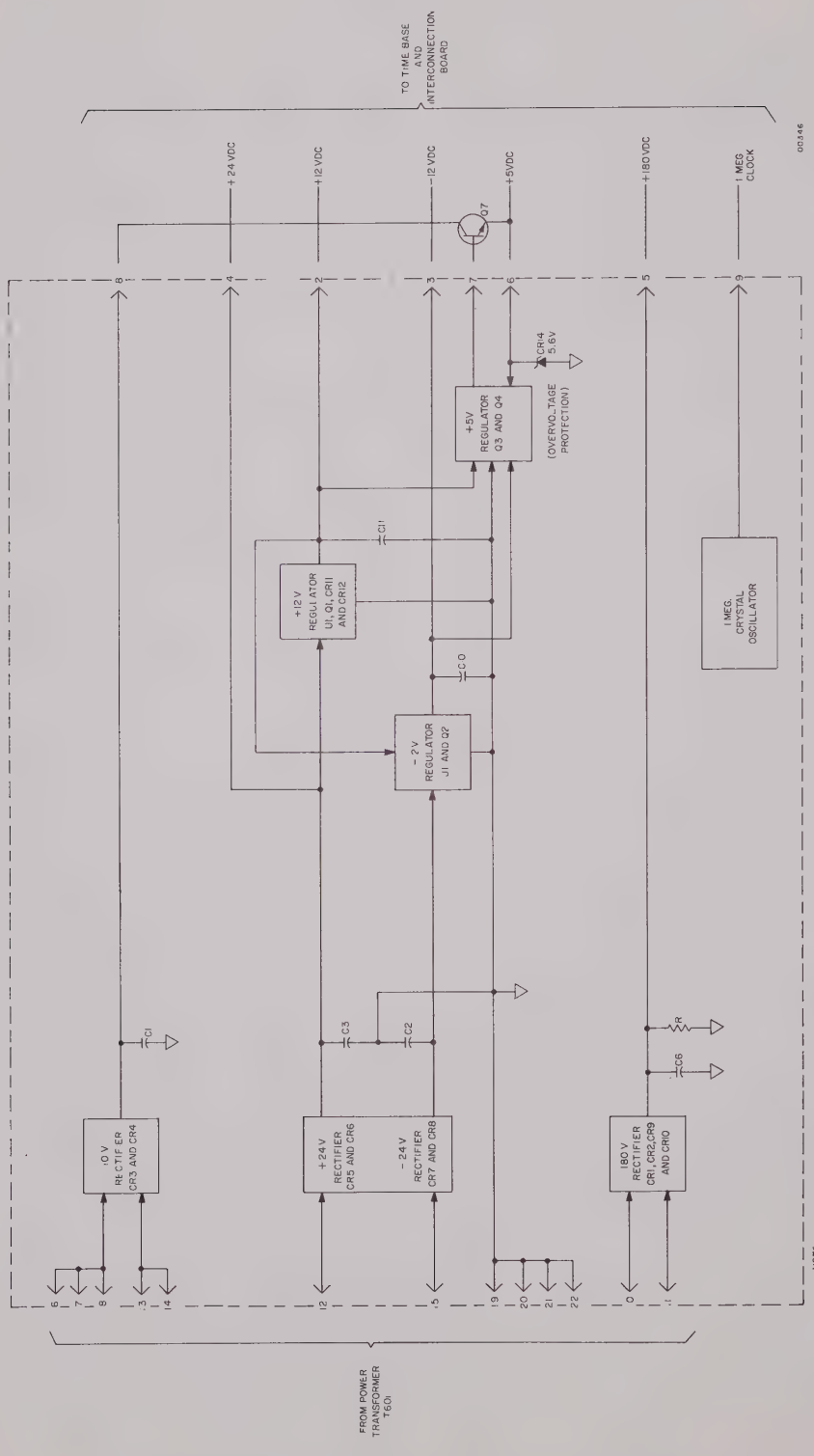


Figure 4-4. Power Supply and Clock Section Block Diagram

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 INTRODUCTUON.

5.2 The Models 2000 and 2000R require no routine maintenance. Should repair maintenance become necessary, the technical data provided by this section used in conjunction with the information contained in Section 4 will facilitate the repair of the instrument. Since it is impossible to predict to any degree of accuracy what, if any, problems the repair man is likely to be faced with, no specific maintenance instructions are provided. Should any repairs be performed it is imperative that the calibration procedures provided by this section be followed explicitly. This will insure the instruments continued high degree of measurement accuracy.

CAUTION

High voltages are present in three areas:
(a) Large input signals at the front panel and input board.

(b) Line voltages (110 or 220V ac) at the front panel and power supply and clock board.

(c) Supply voltage for the readout tubes (210V dc) at the power supply and clock, interconnection, display and annunciator boards.

5.3 LOGIC LEVELS.

5.4 Logic signals having amplitudes less than +0.8 volts correspond to logic zeros. Logic signals having amplitudes greater than +2.4 volts correspond to logic ones.

5.5 MAINTENANCE:

5.6 Table 5-1 lists the correct voltages for each output of the power supply section of the power supply and clock board. Figure 5-1 illustrates the clock output of the power supply and clock board.

Table 5-1. Power Supply Voltages

Test Point	Voltage	Ripple (Peak to Peak)
+180	+180V;+40V,-10V	$\leq$ 4 volts
+ 22	+22V;±4V	$\leq$ 4 volts
+ 12	+12V; ±0.1V	$\leq$ 10 mV
- 12	-12V; ±0.2V	$\leq$ 10 mV
+ 5	+5V; ±0.2V	$\leq$ 100 mV

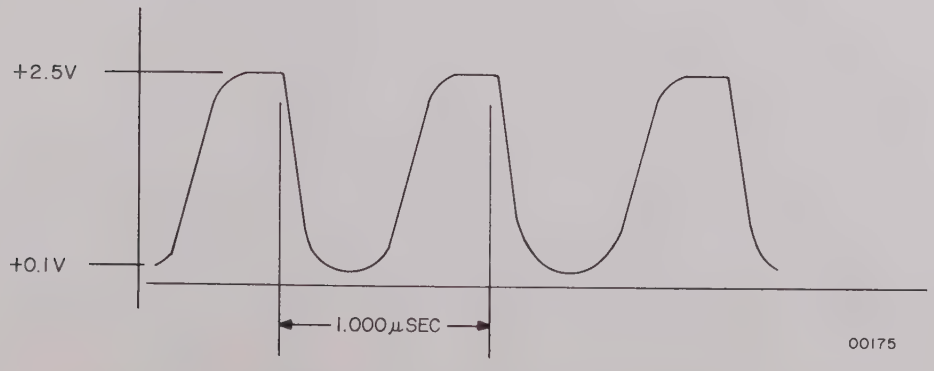
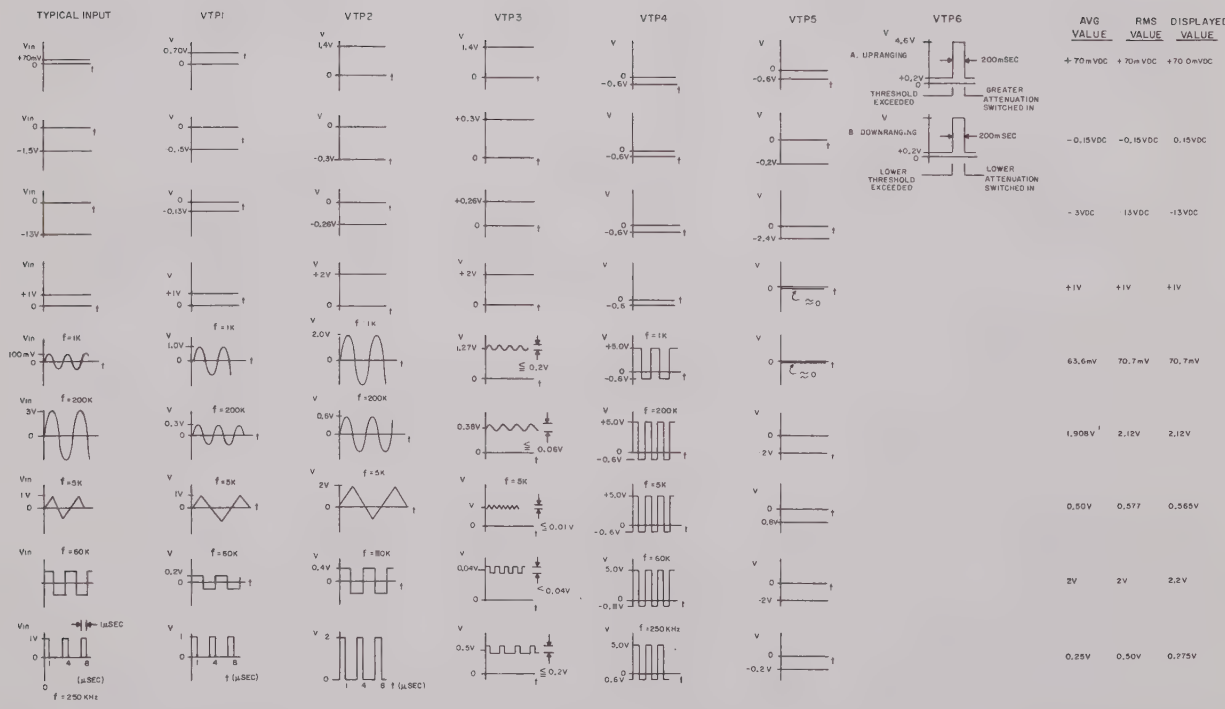


Figure 5-1. Clock Output Waveform



NOTE

1. COUNTER WILL CORRECTLY COUNT AND DISPLAY FREQUENCY OF ANY PERIODIC SIGNAL WHOSE ZERO TO PEAK VALUE EXCEEDS ABOUT 12mV. THE DVM MODES WILL ERR, HOWEVER, WITH OTHER THAN SINUSOIDAL INPUTS.

Figure 5-2. Input Board Waveforms

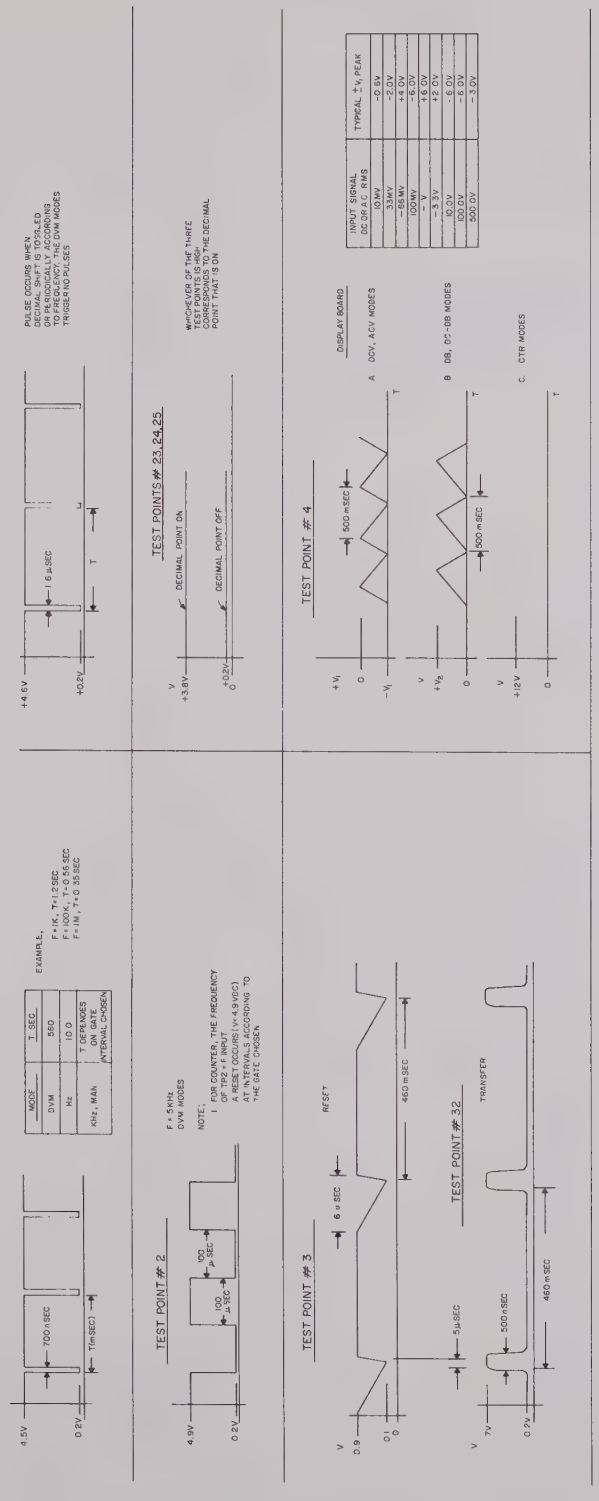


Figure 5-3. Display and Counter Board Output Waveforms

5.7 Figure 5-2 illustrates wave forms and voltage levels found on the input board.

5.8 Figure 5-3 illustrates wave forms and voltage levels found on the display board.

5.9 CALIBRATION.

5.10 Observe the input signal by attaching an oscilloscope to test point 2 (TP2) of the input board. Any noise or other discontinuity appearing at TP2 will affect the accuracy of the instrument.

5.11 POWER SUPPLY.

5.12 Since all the regulated supplies derive reference voltages from the +12 volt supply, the calibration of the +12 volt establishes the output voltages of all the regulated supplies. Table 5-1 lists all the output voltages and test point locations of each supply, vary R9 until the output voltage is +12 volts ±0.1 volts.

5.13 CALIBRATION FOR DC MEASUREMENTS.

5.14 Procedure:

(a) Connect a shorting link from the chassis ground jack to the floating (middle) ground jack on the front panel.

(b) Press the DCV pushbutton.

(c) Remove transistors Q4, Q5, Q7, and Q8 from the input board (refer to figure 6-2).

(d) Connect TP2 on the input board to chassis ground (refer to figure 6-2).

(e) Turn power on.

(f) Adjust R108, on the input board, until 0.0mV dc is measured across R43 (refer to figure 6-2).

(g) Turn power off and replace Q4, Q5, Q7, and Q8 into the input board.

(h) Turn power on, proceed as indicated in table 5-2.

Table 5-2. DC Calibration

INPUT	ADJUST	DESIRED RESULT VDC	AT
short	R21	0.000	TP2
Push CAL	zero pot	0.000	TP2
short	R21	0.000	TP2
push CAL	zero pot	0.000	TP2
Repeat steps a through 10 until both conditions satisfied.			
short	R202*	0.000mV	Display
-1.000V dc	R45	-1.000	Display
+1.000V dc	R217*	+1.000	Display
+100.0mV dc	R13	+100.0mV	Display
+1.000V dc	R217*	+1.000	Display
+100.0mV dc	R13	+100.0mV	Display
+10.00V dc	R8	+10.00	Display
+100.0V dc	none	+100.0±0.2V	Display
+500.0V dc	R11	+0500	Display
+10.00V dc	R8	+10.00	Display
+100.0V dc	none	+100.0±0.2V	Display
+500.0V dc	R11	+0500	Display
	* R202 and R217 appear on the display board (Figure 6-3).		

5.15 CALIBRATION FOR AC MEASUREMENTS.

5.16 The Models 2000 and 2000R are calibrated to display rms values of sinusiodal input signals. Other periodic wave forms can be measured, but the ACV displayed figure will be in error by the appropriate form factor. This characteristic does not affect frequency measurements.

5.17 Procedure:

(a) Press ACV pushbutton and turn the power on, proceed as indicated in Table 5-3.

Table 5-3. AC Calibration

Input	Adjust	Desired Result Displayed
Push CAL	ZERO pot	000.0 mV
1.000 V rms @ 1 kHz	R60	1.000 V
1.000 V rms @ 100 kHz	R41*	1.000 V
100.0 mV rms @ 100 kHz	C8	100.0 mV
10.00 V rms @ 100 kHz	C2	10.00 V
130.00 V rms @ 60 Hz	C4	0130 V
100.00 mV rms @ 100 kHz	C8	100.0 mV
10.00 V rms @ 100 kHz	C2	10.00 V
130.00 V rms @ 60 Hz	C4	0130 V

* Potentiometer R41 may cause the display to peak above 1.000 V in the middle of the pot's swing, and pass through 1.000 V near either extremity. If this occurs, choose the pot setting at 100 kHz that causes the display to be more linear at 200 kHz.

5.18 CALIBRATION FOR DB MEASUREMENTS.

5.19 The accuracy of dB measurements is dependent on the calibration of the ac volts section (paragraphs 5.15-5.17). Calibration in the dB mode should always be preceded by adjusting the display to 000.0V in the ACV mode with the CAL. switch and the ZERO pot on the front panel.

5.20 A precision oscillator and attenuator should be used to calibrate the 1mV or 10mV input levels so that the signal to noise ratio of the input signal does not become detrimental.

5.21 Since the ACV mode is calibrated to closer than 0.1% at the decade levels and, as previously mentioned, the dB mode depends on this accuracy but has a resolution of only 0.1 dB, the displayed dBm figures should be exact and not "within ±0.1 dB". Should a random check prove otherwise, the calibration procedure in the dB mode should be repeated until exact tracking is demonstrated.

5.22 All adjustments in the dB mode will be made at a frequency of 1 kHz.

5.23 Procedure:

(a) Turn power on and procede as indicated in table 5-4.

Table 5-4. DB Calibration

Mode	Input	Adjust	Desired Result	At
ACV	Push CAL	ZERO pot	000.0 mV	Display
dB	100.0 mV	REF pot	0.00 V dc	TP5
dB	1.000 mV	R66	-60.0 dB	Display
dB	10.00 mV	R78	-40.0 dB	Display
dB	100.0 mV	R80	-20.0 dB	Display
dB	Repeat steps c,d, and e until all three conditions are satisfied.			
dB	1.000 V	R84	0.0 dB	Display
dB	10.00 V	R82	+20.0 dB	Display
dB	1.000 V	R84	0.0 dB	Display
dB	10.00 V	R82	+20.0 dB	Display

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION.

6.2 Table 6-1 provides a list of FSCM (Federal Supply Code of Manufacturers) code numbers and corresponding manufacturers. Table 6-2 through 6-9 are the parts list for the Model 2000 and 2000R.

Table 6-1. List of Manufacturers

Code No.	Manufacturer
01121	Allen Bradley Milwaukee, Wis. 53204
01295	Texas Instruments Inc. Dallas, Texas 75231
02660	Amphenol Corp. Broadview, Ill. 60153
03888	Pyrofilm Rsistors Co., Inc. Cedar Knolls, N. J. 07927
04713	Motorola Inc. Semiconductor Products Inc., Phenix, Az. 85008
05397	Union Carbide Corp., N.Y., N. Y. 10017
09353	C&K Components Inc., Newton, Mass. 02158
12065	Transitron Electronic Corp., Boston, Mass. 02128
12954	Dickson Electronics Corp., Scottsdale, Az. 85252
13606	Sprague Electric Co., Concord, N.H. 03301
15818	Teledyne Semiconductor, Mountain View, Calif. 94040
18043	Profile Electronics, Concord, N.H. 03301
18324	Signetics Corp., Sunnyvale, Calif. 94086
19701	Electra/Midlands, Mineral Wells, Texas 76067
22650	Whale Electronics, Nashville, Tenn.
29832	Teledyne Philbrick Nexus, Dedham, Mass
49671	RCA Corp., N.Y., N. Y. 10020
71400	Bussman, St. Louis, Mo. 63017
71450	CTS Corp., Elkhart, Ind. 46514
71590	Centralab, Milwaukee, Wis. 53201
71744	Chicago Miniture Lamp, Chicago, Ill. 60640
72136	Electro Motive Mfg., Willimantic, Conn. 06226
72663	General Controls Co., Boston, Mass. 02134
72982	Erie Technological Products, Erie, Pa. 16512
73138	Beckman Instruments, Heli-Pot Div., Fullerton, Calif. 92634
75915	Littelfuse Inc., Des Planes, Ill. 60016
77342	Potter & Brumfield Sales Co., Chicago, Ill.
81071	Schauer Mfg, Corp., Cincinnati, Ohio 45242
81073	Grayhill, Inc. La Grange, Ill. 60525
82389	Switchcraft Inc., Chicago, Ill. 60630
83594	Burroughs Corp., Electronic Components Div., Plainfield, N.J. 07061
84411	TRW Capacitor Div., Ogallala, Nebr.
94304	Lunn Laminates Inc., Wyandanch Long Island, N.Y. 11798

Table 6-2. Model 2000 Overall Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
F601	.5A 00 250V	71400	MDL	863101900
J601	BINDING POST-BLK	81073	29-18	652400300
J602	SAME AS J601			
J603	BINDING POST-RED	81073	29-1R	652400400
J604	3-PIN MALE RECEPT-GND	82389	AC3G	652300100
J606	5A 00 600V	02660	225-22221-101	651701000
PC1	E95725 ASSY			A200000011
PC2	E95804 ASSY			A200000012
PC3	E95892 ASSY			A200000013
PC4	E95748 ASSY			A200000014
Q601	TO3LPA 115W 00 60V	49671	2N3055	550030550
R601	1K 500MW 00	71450	5VA45-1K	233101020
R602	250K 250MW 00	71450	5VA45-250K	233102540
R603	56- 1/4W 10%	01121	TYPE CB	200105606
S601	SPDT 5A 00 28V	09353	7101HP SPDT	620402100
S602	SPDT 5A 00 28V	09353	7109HP	620402200
S603	3A 00 125V	82389	46206LF	645500200
S604	SPDT RED	82389	903	635400100
T601		18043	NEC-1C	420200500

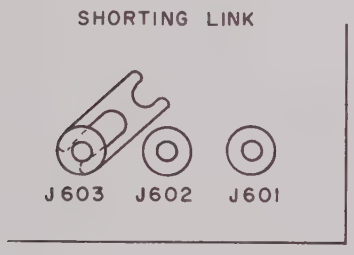


FIG. 1
FRONT SIDE OF FRONT PANEL

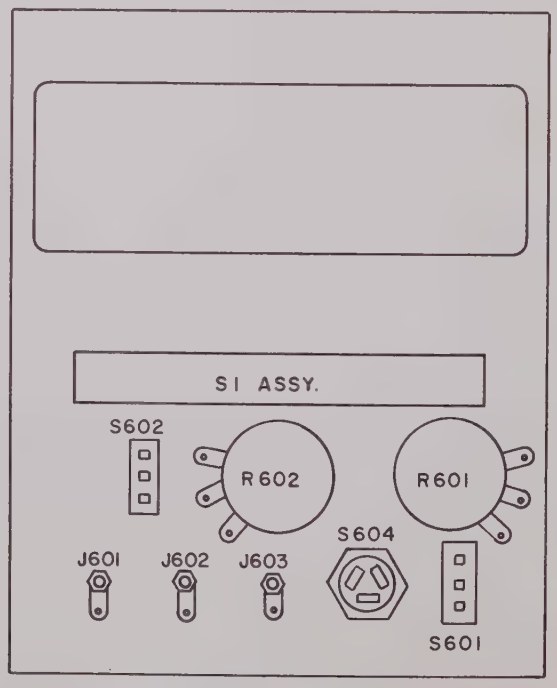


Figure 6-1. Model 2000 Front Panel Assembly

Table 6-3. PC1 Assembly E95725 Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	.1MF		10%	600V	13606	6PS-P10	321201040
C2	8-35PF		00	200V	72982	539-002-142D	340103500
C3	1200PF	%50	5%	500V	72136	CM15-E122J	335001220
C4	SAME AS C2						
C5	.012UF		5%	50V	84411	X440	335301230
C6	39PF		10%	100V	72982	8121100C0G390K	330803900
C7	170UF		00	6V	22650	16-437-170-6-8NA	301301770
C8	1.5-8PF		00	200V	72982	539-002-A1.5-8	340100800
C9	150PF		5%	500V	72136	CM15-E151J	335001510
C10	SAME AS C9						
C11	820PF		5%	100V	72136	CM15-E821J	335008210
C12	1MF		10%	35V	05397	T330A105K035AS	310001051
C13	SAME AS C11						
C14	SAME AS C12						
C15	68PF		5%	500V	72136	CM15-E680J	335006800
C16	22MF		10%	6V	05397	T330A226K006AS	310002260
C17	SAME AS C15						
C18	EL.VAL.		5%	500V	72136	CM15-	335000000
C19	.01MF		20%	1KV	71590	DD-103	330101030
C20	1000PF		10%	1KV	71590	DD-102	330001020
C21	10MF		10%	10V	05397	T330A106K010AS	310001060
C22	270PF		10%	1KV	71590	DD-271	330002710
C23	.1MF		30%	75V	71590	DDA-104	330201040
C24	10PF		10%	1KV	71590	DD-100	330001000
C25	100PF		10%	1KV	71590	DD-101	330001010
C26	SAME AS C24						
C27	SAME AS C25						
C28	SAME AS C21						
C29	SAME AS C21						
CR1	DO35	500MW	00	20V	12065	1N4148	560041480
CR2	DO-7	IF		40V	G.E.	SE708	560007080
CR3	SAME AS CR2						
CR4	SAME AS CR1						
CR5	SAME AS CR1						
CR6	70V BRKDOWN				94304	5082-2800	561550820
CR7	SAME AS CR6						
CR8T	SAME AS CR1						
CR21	SAME AS CR1						
K1	.87K		00	24V	77342	HP-11D	604100400
K2	SAME AS K1						
K3	SAME AS K1						
Q1	TO92AFA	310MW	00	25V	04713	MPS6519	552065190
Q2	TO92AFA	310MW	00	25V	04713	MPS6515	550065150
Q3	SAME AS Q1						
Q4	SAME AS Q1						
Q5	SAME AS Q2						
Q6	SAME AS Q2						
Q7	SAME AS Q2						
Q8	SAME AS Q1						
Q9	TO92HSS	310MW	00	40V	04713	2N3903	550039030
Q10	SAME AS Q9						
Q11	SAME AS Q9						
Q12	SAME AS Q9						
Q13	SAME AS Q9						
Q14	SAME AS Q9						
R1	100K	1/8W	1%		19701	MF5C	220210031
R2	1000-	1/8W	1%		19701	MF5C	220210011

Table 6-3. PC1 Assembly E95725 Parts List (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R3	10K 1/4W 10%	01121	TYPE CB	200101036
R4	SAME AS R3			
R5	SAME AS R3			
R6	10M 1W 1%	03888	PME70	221410051
R7	97.6K 1/8W 1%	19701	MF5C	220297621
R8	10K 1/2W 10% 200V	73138	62P10K	232701036
R9	SAME AS R6			
R10	9760- 1/8W 1%	19701	MF5C	220297611
R11	1K 1/2W 10% 200V	73138	62P1K	232701026
R12	21.5K 1/8W 1%	19701	MF5C	220221521
R13	100- 1/2W 10% 200V HILIPOT		62P100	232701016
R14	1/8W 1%	19701	MF5C	220200000
R15	953- 1/8W 1%	19701	MF5C	220295301
R16	82.5K 1/8W 1%	19701	MF5C	220282521
R17	9090- 1/8W 1%	19701	MF5C	220290911
R18	15K 1/8W 1%	19701	MF5C	220215021
R19	SAME AS R6			
R20	SAME AS R18			
R21	1K 1/2W 10% 200V HILIPOT		66WR1K	232701023
R22	2150- 1/8W 1%	19701	MF5C	220221511
R23	3830- 1/8W 1%	19701	MF5C	220238311
R24	SAME AS R23			
R25	SAME AS R22			
R26	909- 1/8W 1%	19701	MF5C	220290901
R27	215- 1/8W 1%	19701	MF5C	220221501
R28	5110- 1/8W 1%	19701	MF5C	220251111
R29	SAME AS R28			
R30	SAME AS R26			
R31	SAME AS R27			
R32	SAME AS R22			
R33	SAME AS R22			
R34	6.8K 1/4W 10%	01121	TYPE CB	200106826
R35	SAME AS R34			
R36	3740- 1/8W 1%	19701	MF5C	220237411
R37	511- 1/8W 1%	19701	MF5C	220251101
R38	SAME AS R37			
R39	SAME AS R36			
R40	255- 1/8W 1%	19701	MF5C	220225501
R41	20K 1/2W 10% 200V HILIPOT		62P20K	232702036
R42	499- 1/8W 1%	19701	MF5C	220249901
R43	280- 1/8W 1%	19701	MF5C	220228001
R44	24.3K 1/8W 1%	19701	MF5C	220224321
R45	2K 1/2W 10% 200V HILIPOT		62P2K	232702026
R46	SAME AS R3			
R47	220- 1/4W 10%	01121	TYPE CB	200102216
R48	2.7K 1/4W 10%	01121	TYPE CB	200102726
R49	3.9K 1/4W 10%	01121	TYPE CB	200103926
R50	18K 1/4W 10%	01121	TYPE CB	200101836
R51	1K 1/4W 10%	01121	TYPE CB	200101026
R52	8.2K 1/4W 10%	01121	TYPE CB	200108226
R53	SAME AS R50			
R54	SAME AS R49			
R55	1.5K 1/4W 10%	01121	TYPE CB	200101526
R56	SAME AS R28			
R57	10.5K 1/8W 1%	19701	MF5C	220210521
R58	SAME AS R55			
R59	21K 1/8W 1%	19701	MF5C	220221021
R60	5K 1/2W 10% 200V HILIPOT		62P5K	232705026
R61	12.1K 1/8W 1%	19701	MF5C	220212121
R62	SAME AS R61			
R63	24.98K 1/8W 1%	19701	MF5C	220224921
R64	4530- 1/8W 1%	19701	MF5C	220245311

Table 6-3. PC1 Assembly E95725 Parts List (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R65	3.92K 1/8W 1%	19701	MF5C	220239211
R66	SAME AS R45			
R67	243K 1/8W 1%	19701	MF5C	220224331
R68	SAME AS R2			
R69	SAME AS R1			
R70	75K 1/8W 1%	19701	MF5C	220275021
R71	SAME AS R28			
R72	SAME AS R28			
R73	31.6K 1/8W 1%	19701	MF5C	220231621
R74	SAME AS R28			
R75	28.7K 1/8W 1%	19701	MF5C	220228721
R76	SAME AS R28			
R77	182K 1/8W 1%	19701	MF5C	220218231
R78	SAME AS R41			
R79	SAME AS R3			
R80	50K 1/2W 10% 200V	HILIPUT	62P50K	232705036
R81	732K 1/8W 1%	19701	MF5C	220273231
R82	SAME AS R41			
R83	365K 1/8W 1%	19701	MF5C	220236531
R84	SAME AS R80			
R85	715K 1/8W 1%	19701	MF5C	220271531
R86	4.7K 1/4W 10%	01121	TYPE CB	200104726
R87	SAME AS R86			
R88	SAME AS R86			
R89	100K 1/4W 10%	01121	TYPE CB	200101046
R90	SAME AS R86			
R91	SAME AS R3			
R92	SAME AS R89			
R93	SAME AS R51			
R94	SAME AS R89			
R95	3.3K 1/4W 10%	01121	TYPE CB	200103326
R96	SAME AS R3			
R97	SAME AS R3			
R98	SAME AS R55			
R99	SAME AS R55			
R100	158- 1/8W 1%	19701	MF5C	220215801
R101	SAME AS R61			
R102	10K 1/8W 1%	19701	MF5C	220210021
R103	2370- 1/8W 1%	19701	MF5C	220223711
R104	SAME AS R17			
R105	SAME AS R102			
R106	SAME AS R3			
R107	SAME AS R89			
R108	200- 1/2W 10% 200V	73138	62P200	232702011
S1	PB15,6POS,1PP,5IL			A200000111
U1	7PA-4P	PHIL NEXUS	1027-01	501010271
U2	14DILP 00	49671	CA3045	500030450
U4	8PDIL 00MW 00 180	18324	N5741V	500057410
U5	10P T05	17803	U5U7726323	500007260
U6	8PDIL 80MW 00 180	18324	N5558V	500055580
U7	14DILP 00	18324	SP370A	510003700
U8	14DILP 00	18324	SP380A	510003800
U9	14DILP 00	18324	N8285A	510082850
U10	14DILP 00	18324	SP317A	510003170
U11	SAME AS U10			
U12	SAME AS U8			
U13	14DILP 00	12065	TOA2809P	500008090

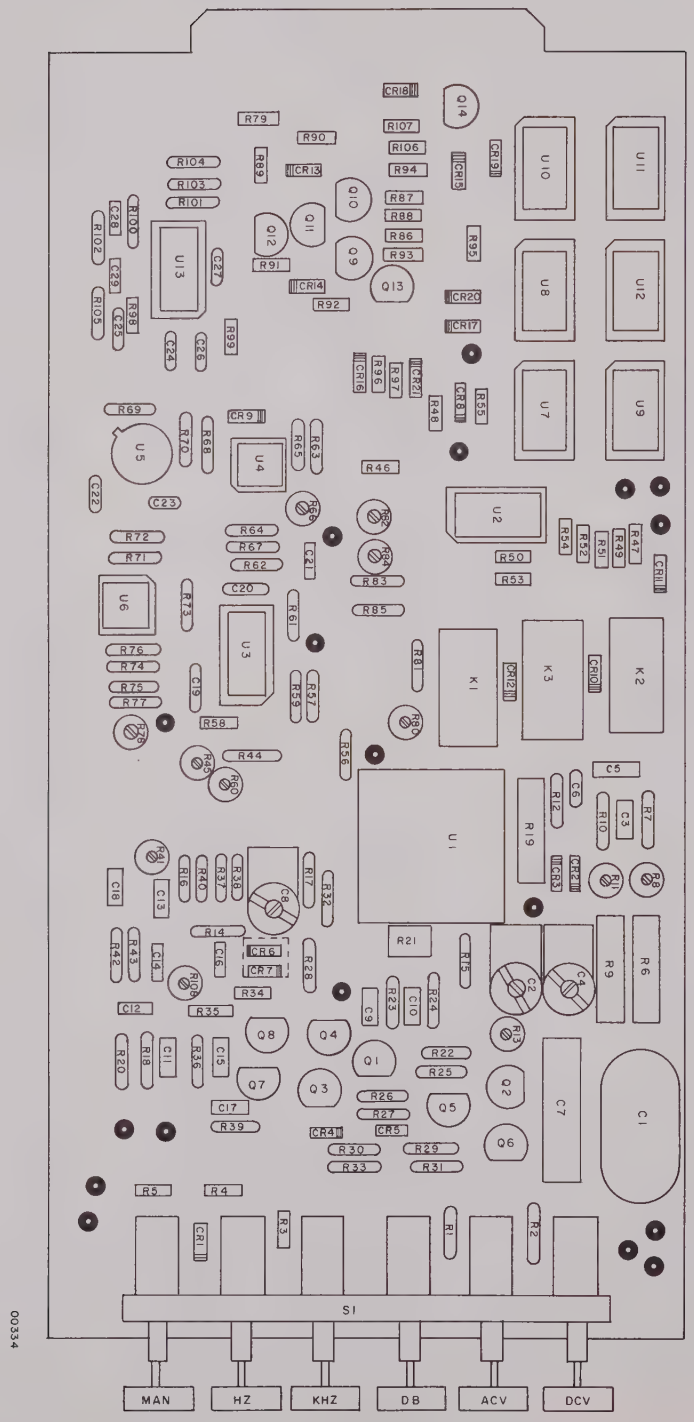


Figure 6-2. Models 2000 and 2000R Input Board (PC1)

Table 6-4. PC2 Assembly E95804 Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	10MF		10%	10V	05397	T330A106K010AS	310001060
C2	2200PF		10%	1KV	71590	DD-222	330002220
C3	220PF		10%	1KV	71590	DD-221	330002210
C4	SAME AS C1						
C5	SAME AS C3						
C6	100PF		10%	1KV	71590	DD-101	330001010
C7	470PF		10%	1KV	71590	DD-471	330004710
C8	SAME AS C6						
C9	3000PF		10%	1KV	71590	DD-302	330003020
C10	SAME AS C7						
C11	200PF		10%	1KV	71590	DD-201	330002010
C12	SAME AS C11						
C13	47PF		10%	1KV	71590	DD-470	330004700
C14	22MF		10%	6V	05397	T330A226K006AS	310002260
C15	.1MF		10%	50V	05397	T330A104K050AS	310001040
C16	SAME AS C15						
CR1	DO35	500MW	00	20V	12065	1N4148	560041480
CR2	SAME AS CR1						
CR3	SAME AS CR1						
CR4	SAME AS CR1						
CR5	SAME AS CR1						
CR6			00	200V	12065	1N4003	560040030
CR7	SAME AS CR1						
CR8	SAME AS CR1						
CR9	SAME AS CR1						
CR10	SAME AS CR1						
CR11	SAME AS CR1						
CR12	SAME AS CR1						
CR13	SAME AS CR1						
CR14	SAME AS CR1						
CR15	SAME AS CR1						
CR16	SAME AS CR1						
CR17	SAME AS CR1						
CR18	SAME AS CR1						
CR19	SAME AS CR1						
CR20	SAME AS CR1						
Q1	TO92HSS	310MW	00	40V	04713	2N3903	550039030
Q2	SAME AS Q1						
Q3		300MW		30V	AMELCO	P1087E	555001087
Q4	SAME AS Q3						
Q5	SAME AS Q3						
Q6	SAME AS Q1						
Q7	SAME AS Q1						
Q8	SAME AS Q1						
Q9	SAME AS Q1						
Q10	SAME AS Q1						
Q11	TO5RFA	5W	00		49671	40327	550040327
Q12	SAME AS Q11						
Q13	SAME AS Q11						
Q14	SAME AS Q11						
Q15	SAME AS Q1						
Q16	SAME AS Q11						
Q17	SAME AS Q11						
Q18	SAME AS Q11						
Q19	SAME AS Q11						
Q20	SAME AS Q11						
Q21	SAME AS Q11						
Q22	SAME AS Q3						

Table 6-4. PC2 Assembly E95804 Parts List (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
Q23	SAME AS Q3			
Q24	SAME AS Q1			
R1	10K 1/8W 1%	19701	MF5C	220210021
R2	20K 1/2W 10% 200V HILIPOT	62P20K		232702036
R3	SAME AS R1			
R4	1M 1/4W 10%	01121	TYPE CB	200101056
R5	3.3K 1/4W 10%	01121	TYPE CB	200103326
R6	10K 1/4W 10%	01121	TYPE CB	200101036
R7	SAME AS R6			
R8	100K 1/4W 10%	01121	TYPE CB	200101046
R9	SAME AS R8			
R10	SAME AS R8			
R11	1.5K 1/4W 10%	01121	TYPE CB	200101526
R12	SAME AS R6			
R13	SAME AS R8			
R14	75K 1/8W 1%	19701	MF5C	220275021
R15	SAME AS R11			
R16	SAME AS R6			
R17	5K 1/2W 10% 200V HILIPOT	62P5K		232705026
R18	34.8K 1/8W 1%	19701	MF5C	220234821
R19	SAME AS R8			
R20	2.7K 1/4W 10%	01121	TYPE CB	200102726
R21	4.7K 1/4W 10%	01121	TYPE CB	200104726
R22	SAME AS R21			
R23	3.9K 1/4W 10%	01121	TYPE CB	200103926
R24	2.2K 1/4W 10%	01121	TYPE CB	200102226
R25	SAME AS R21			
R26	SAME AS R8			
R27	SAME AS R24			
R28	SAME AS R21			
R29	SAME AS R8			
R30	SAME AS R5			
R31	15K 1/4W 10%	01121	TYPE CB	200101536
R32	SAME AS R24			
R33	SAME AS R24			
R34	SAME AS R24			
R35	SAME AS R24			
R36	SAME AS R24			
R37	SAME AS R24			
R38	SAME AS R24			
R39	SAME AS R21			
R40	470- 1/4W 10%	01121	TYPE CB	200104716
R41	SAME AS R40			
R42	SAME AS R8			
R43	SAME AS R24			
R44	SAME AS R5			
R45	SAME AS R21			
R46	SAME AS R21			
R47	SAME AS R21			
R48	SAME AS R21			
R49	SAME AS R21			
R50	SAME AS R21			
R51	33K 1/4W 10%	01121	TYPE CB	200103336
R52	SAME AS R51			
R53	SAME AS R51			
R54	SAME AS R51			
R55	SAME AS R51			
R56	220- 1/4W 10%	01121	TYPE CB	200102216
R57	SAME AS R6			
R58	SAME AS R6			

Table 6-4. PC2 Assembly E95804 Parts List (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R59	SAME AS R21			
R60	SAME AS R8			
R61	SAME AS R21			
R62	SAME AS R8			
R63	SAME AS R21			
R64	SAME AS R8			
R65	SAME AS R8			
R66	SAME AS R56			
R67	SAME AS R8			
R68	220K 1/4W 10%	01121	TYPE CB	200102246
R69	SAME AS R6			
R70	SAME AS R6			
R71	SAME AS R20			
U1	14DILP 00	12065	TOA2809P	500008090
U2	14DILP 00	01295	SN7401N	510074010
U3	SAME AS U2			
U4	14DILP 00	18324	SP380A	510003800
U5	SAME AS U4			
U6	SAME AS U4			
U7	16DILP 00	18324	SP322B	510003220
U8	SAME AS U7			
U9	SAME AS U4			
U10	14DILP 00	18324	SP306A	510003060
U11	14DILP 00	18324	SP370A	510003700
U12	16DILP 00	01295	SN7475N	510074750
U13	14DILP 00	01295	SN7490N	510074900
U14	SAME AS U13			
U15	SAME AS U13			
U16	SAME AS U13			
U17	SAME AS U12			
U18	SAME AS U12			
U19	SAME AS U12			
U20	SAME AS U12			
U21	14DILP 00	01295	SN7441AN	510074411
U22	SAME AS U21			
U23	SAME AS U21			
U24	SAME AS U21			
V1	0-9 RH-LH DECIMAL	BURROUGHS	B-5870	720100100
V2	SAME AS V1			
V3	SAME AS V1			
V4	SAME AS V1			
V5	PLUS OR MINUS,RH DECIMAL	BURROUGHS	B-5866	720100300

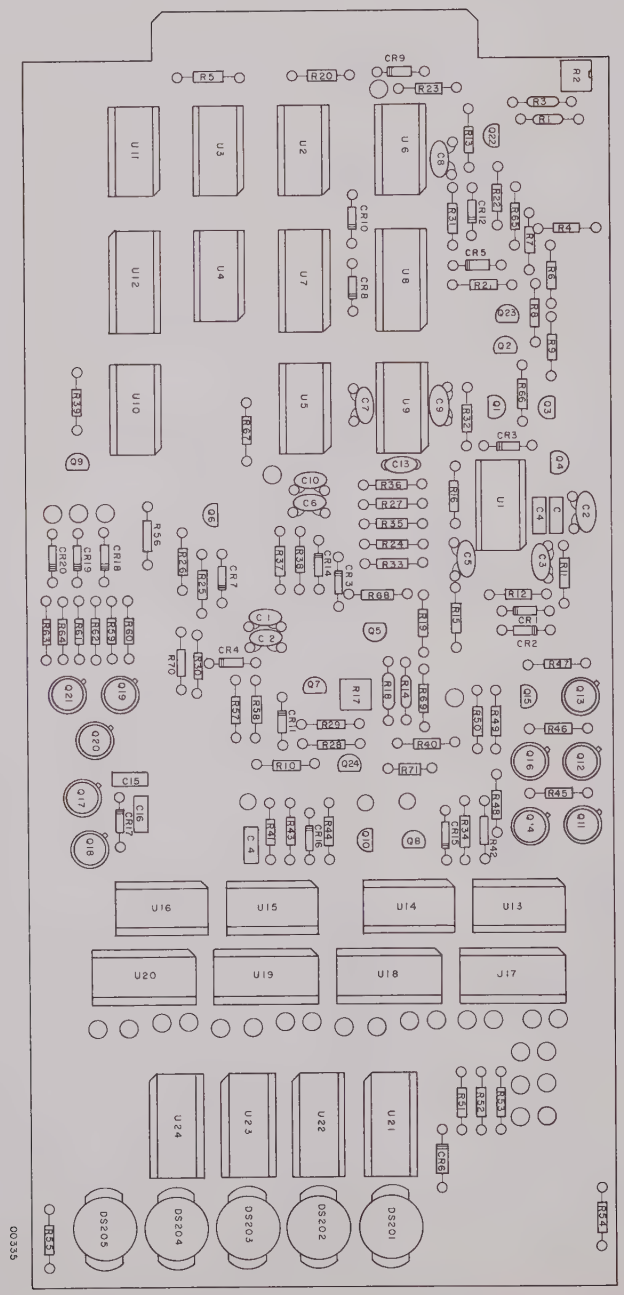
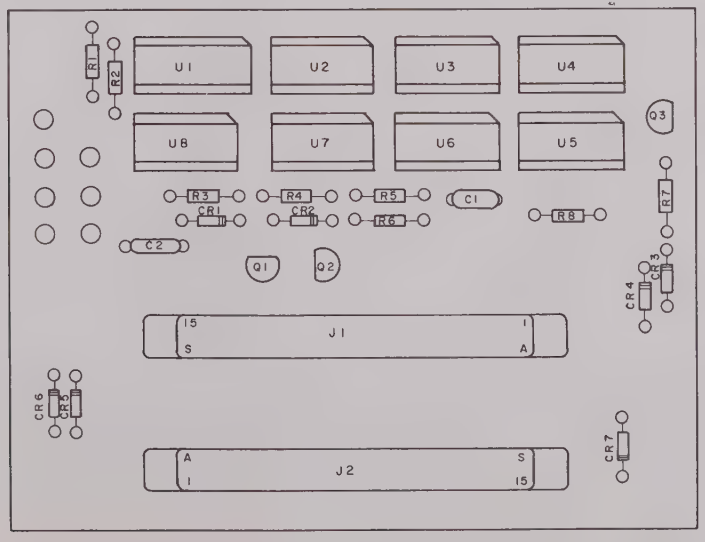


Figure 6-3. Models 2000 and 2000R Counter and Display Board (PC2)

Table 6-5. PC3 Assembly E95892 Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	330UF		20%	6V	13606	196D337X0006MA3	310803370
C2	.1MF		30%	75V	71590	DDA-104	330201040
CR1	DO35	500MW	00	20V	12065	1N4148	560041480
CR2	SAME AS CR1						
CR3	SAME AS CR1						
CR4	SAME AS CR1						
CR5	SAME AS CR1						
CR6	SAME AS CR1						
CR7	SAME AS CR1						
Q1	TO92HSS	310MW	00	40V	04713	2N3903	550039030
Q2	SAME AS Q1						
Q3	SAME AS Q1						
R1	1.2K	1/4W	10%		01121	TYPE CB	200101226
R2	3.9K	1/4W	10%		01121	TYPE CB	200103926
R3	4.7K	1/4W	10%		01121	TYPE CB	200104726
R4	SAME AS R3						
R5	100K	1/4W	10%		01121	TYPE CB	200101046
R6	SAME AS R5						
R7	SAME AS R5						
R8	47-	1/4W	10%		01121	TYPE CB	200104706
U1	16DILP		00		18324	SP322B	510003220
U2	14DILP		00		01295	SN7490N	510074900
U3	SAME AS U2						
U4	SAME AS U2						
U5	SAME AS U2						
U6	SAME AS U2						
U7	SAME AS U2						
U8	SAME AS U2						



00336

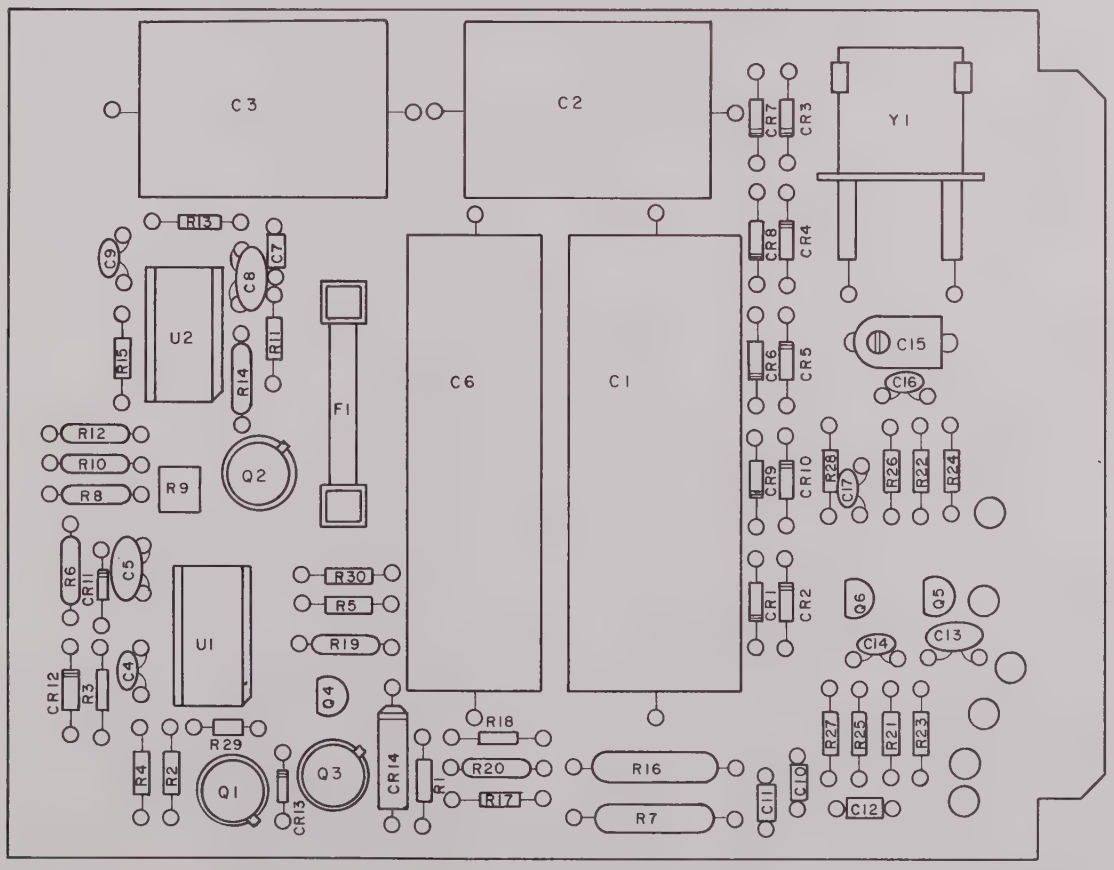
Figure 6-4. Model 2000 Time Base and Interconnection (PC3)

Table 6-6. PC4 Assembly E95748 Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	4000MF		00	15V	13606	39D408G015JL4	300004081
C2	250MF		00	50V	13606	39D257G050HE4	300002570
C3	SAME AS C2						
C4	220PF		10%	1KV	71590	DD-221	330002210
C5	5000PF		10%	1KV	71590	DD-502	330005020
C6	50MF		00	300V	13606	39D506300GC4	300005060
C7	4.7UF		20%	35V	13606	196D475X0035JA1	310804750
C8	SAME AS C5						
C9	SAME AS C4						
C10	SAME AS C7						
C11	SAME AS C7						
C12	SAME AS C7						
C13	2200PF		10%	1KV	71590	DD-222	330002220
C14	SAME AS C4						
C15	8-35PF		00	200V	72982	539-002-142D	340103500
C16	100PF		5%	1KV	13606	10TCC-T10	330301010
C17	SAME AS C13						
CR1	A38AH		00	600V	01295	1N2071	560020710
CR2	SAME AS CR1						
CR3			00	200V	12065	1N4003	560040030
CR4	SAME AS CR3						
CR5	SAME AS CR3						
CR6	SAME AS CR3						
CR7	SAME AS CR3						
CR8	SAME AS CR3						
CR9	SAME AS CR1						
CR10	SAME AS CR1						
CR11	DO35	500MW	00	20V	12065	1N4148	560041480
CR12	DO-7	250MW	5%	6.2V	12954	1N823	563008230
CR13	SAME AS CR11						
CR14	A140	1W	1%	5.6V	81071	SZ5.6	562000560
F1		2A	00	250V	75915	3AG	863100600
PC4							C200000014
Q1	TO5MSS	1W	00	40V	49671	2N3053	550030530
Q2	TO5MSS	5W	00	65V	49671	2N4036	552040360
Q3	SAME AS Q1						
Q4	TO92HSS	310MW	00	40V	04713	2N3903	550039030
Q5	SAME AS Q4						
Q6	SAME AS Q4						
R1	1M	1/4W	10%		01121	TYPE CB	200101056
R2	10K	1/4W	10%		01121	TYPE CB	200101036
R3	2.2K	1/4W	10%		01121	TYPE CB	200102226
R4	100-	1/4W	10%		01121	TYPE CB	200101016
R5	1.5K	1/4W	10%		01121	TYPE CB	200101526
R6	1210-	1/8W	1%		19701	MF5C	220212111
R7	237-	1/2W	1%		19701	MF7C	220623701
R8	5110-	1/8W	1%		19701	MF5C	220251111
R9	2K	1/2W	10%	200V	HILIPOT	62P2K	232702026
R10	SAME AS R8						
R11	1.2K	1/4W	10%		01121	TYPE CB	200101226
R12	SAME AS R8						
R13	SAME AS R5						
R14	SAME AS R8						
R15	SAME AS R4						
R16	332-	1/2W	1%		19701	MF7C	220633201

Table 6-6. PC4 Assembly E95748 Parts List (cont)

REFERENCE DESIGNATOR	DESCRIPTION		MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R17	3.9K	1/4W 10%	01121	TYPE CB	200103926
R18	6.8K	1/4W 10%	01121	TYPE CB	200106826
R19	SAME AS R8				
R20	12.1K	1/8W 1%	19701	MF5C	220212121
R21	27K	1/4W 10%	01121	TYPE CB	200102736
R22	SAME AS R2				
R23	1K	1/4W 10%	01121	TYPE CB	200101026
R24	SAME AS R23				
R25	SAME AS R23				
R26	SAME AS R23				
R27	SAME AS R21				
R28	SAME AS R2				
R29	68-	1/4W 10%	01121	TYPE CB	200106806
R30	82-	1/4W 10%	01121	TYPE CB	200108206
U1	14DILP	00	01295	SN72709N14P	500007090
U2	SAME AS U1				



00337

Figure 6-5. Models 2000 and 2000R Power Supply and Clock Board (PC4)

Table 6-7. PC 5 Assembly E95893 Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
DS1	1/5W 00 105V	71744	NE-2H	730001300
DS2	SAME AS DS1			
DS3	SAME AS DS1			
DS4	SAME AS DS1			
DS5	SAME AS DS1			
R1	68K 1/4W 10%	01121	TYPE CB	200106836
R2	SAME AS R1			
R3	SAME AS R1			
R4	SAME AS R1			
R5	SAME AS R1			

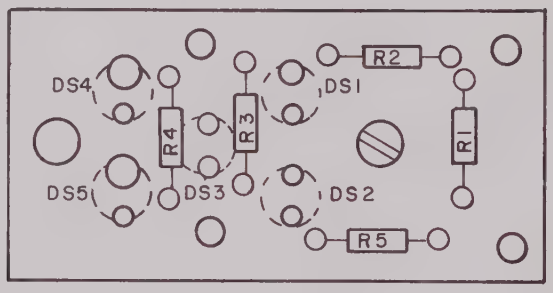


Figure 6-6. Models 2000 and 2000R Annunciator Assembly (PC5)

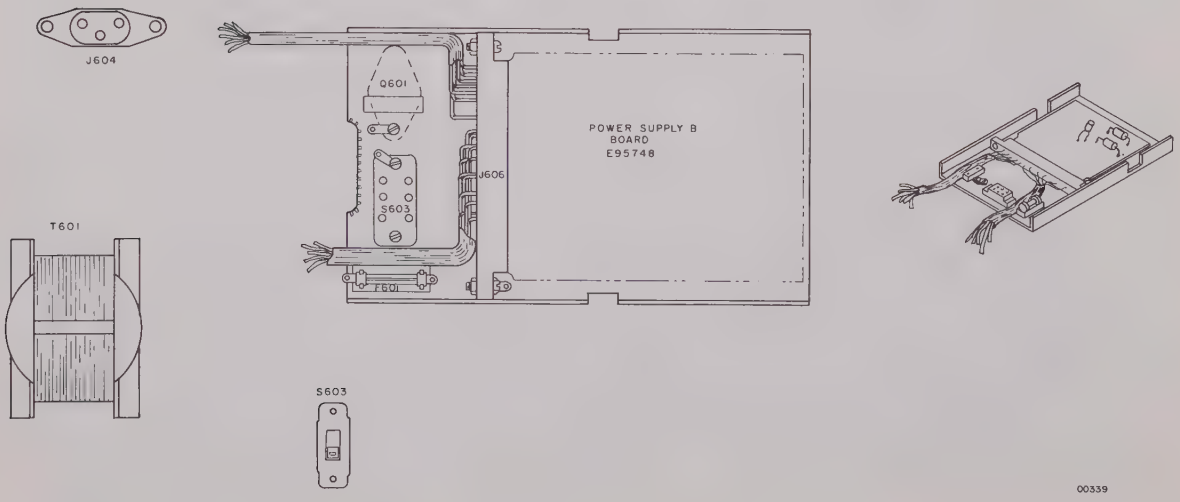


Figure 6-7. Model 2000 Power Supply Assembly

Table 6-8. Model 2000R Overall Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
F601	.5A 00 250V	71400	MDL	863101900
J601	BINDING POST-BLK	81073	29-18	652400300
J601B	SAME AS J601			
J602	SAME AS J601			
J602B	SAME AS J601			
J603	BINDING POST-RED	81073	29-1R	652400400
J603B	SAME AS J603			
J604	3-PIN MALE RECEPT-GND	82389	AC3G	652300100
J606	5A 00 600V	02660	225-22221-101	651701000
PC1	E95725 ASSY			A200000011
PC2	E95804 ASSY			A200000012
PC3	E95805 ASSY			A200010010
PC4	E95748 ASSY			A200000014
Q601	TO3LPA 115W 00 60V	49671	2N3055	550030550
R601	1K 500MW 00	71450	5VA45-1K	233101020
R602	250K 250MW 00	71450	5VA45-250K	233102540
R603	56- 1/4W 10%	01121	TYPE CB	200105606
S601	SPDT 5A 00 28V	09353	7101HP SPDT	620402100
S602	SPDT 5A 00 28V	09353	7109HP	620402200
S603	3A 00 125V	82389	46206LF	645500200
S604	SPDT RED	82389	903	635400100
T601	SCHEMATIC MOD-2000			A200000303

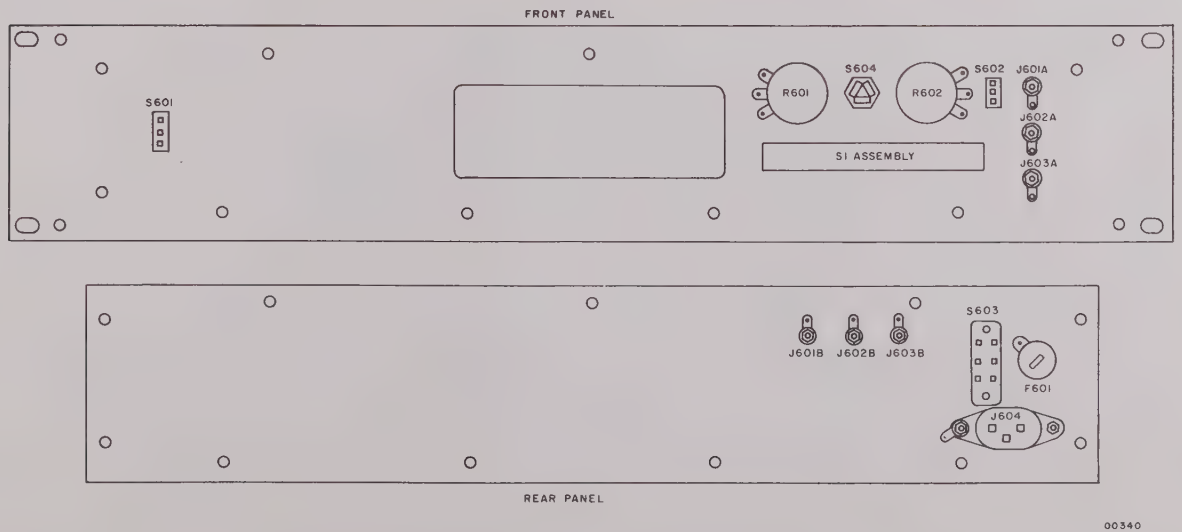


Figure 6-8. Model 2000R Front and Rear Panel Assemblies

Table 6-9. Model 2000R PC3 Assembly E95805 Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	330UF		20%	6V	13606	196D337X0006MA3	310803370
C2	.1MF		30%	75V	71590	DDA-104	330201040
CR1	DO35	500MW	00	20V	12065	1N4148	560041480
CR7	SAME AS CR1						
Q1	TO92HSS	310MW	00	40V	04713	2N3903	550039030
Q2	SAME AS Q1						
Q3	SAME AS Q1						
R1	1.2K	1/4W	10%		01121	TYPE CB	200101226
R2	3.9K	1/4W	10%		01121	TYPE CB	200103926
R3	4.7K	1/4W	10%		01121	TYPE CB	200104726
R4	SAME AS R3						
R5	100K	1/4W	10%		01121	TYPE CB	200101046
R6	SAME AS R5						
R7	SAME AS R5						
R8	47-	1/4W	10%		01121	TYPE CB	200104706
U1	16DILP		00		18324	SP322B	510003220
U2	14DILP		00		01295	SN7490N	510074900
U3	SAME AS U2						
U4	SAME AS U2						
U5	SAME AS U2						
U6	SAME AS U2						
U7	SAME AS U2						
U8	SAME AS U2						

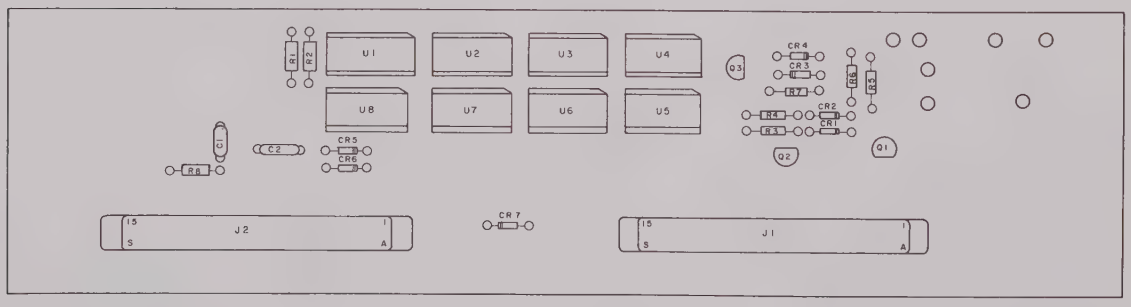


Figure 6-9. Model 2000R Time Base (PC3)

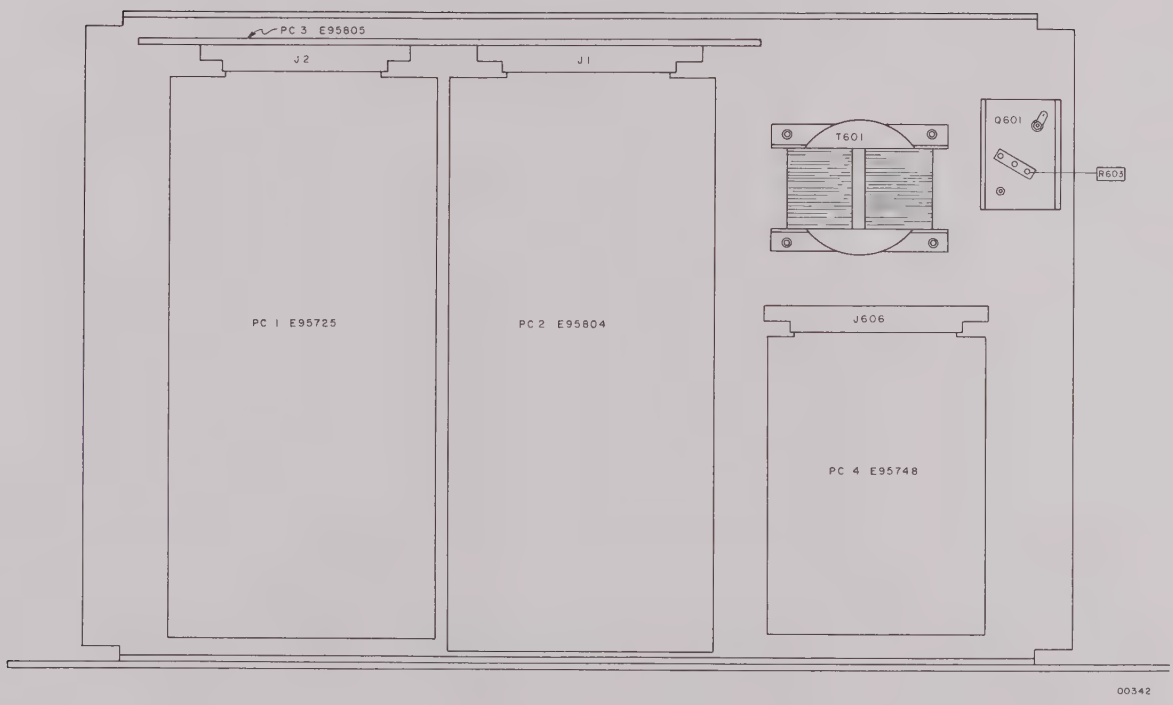


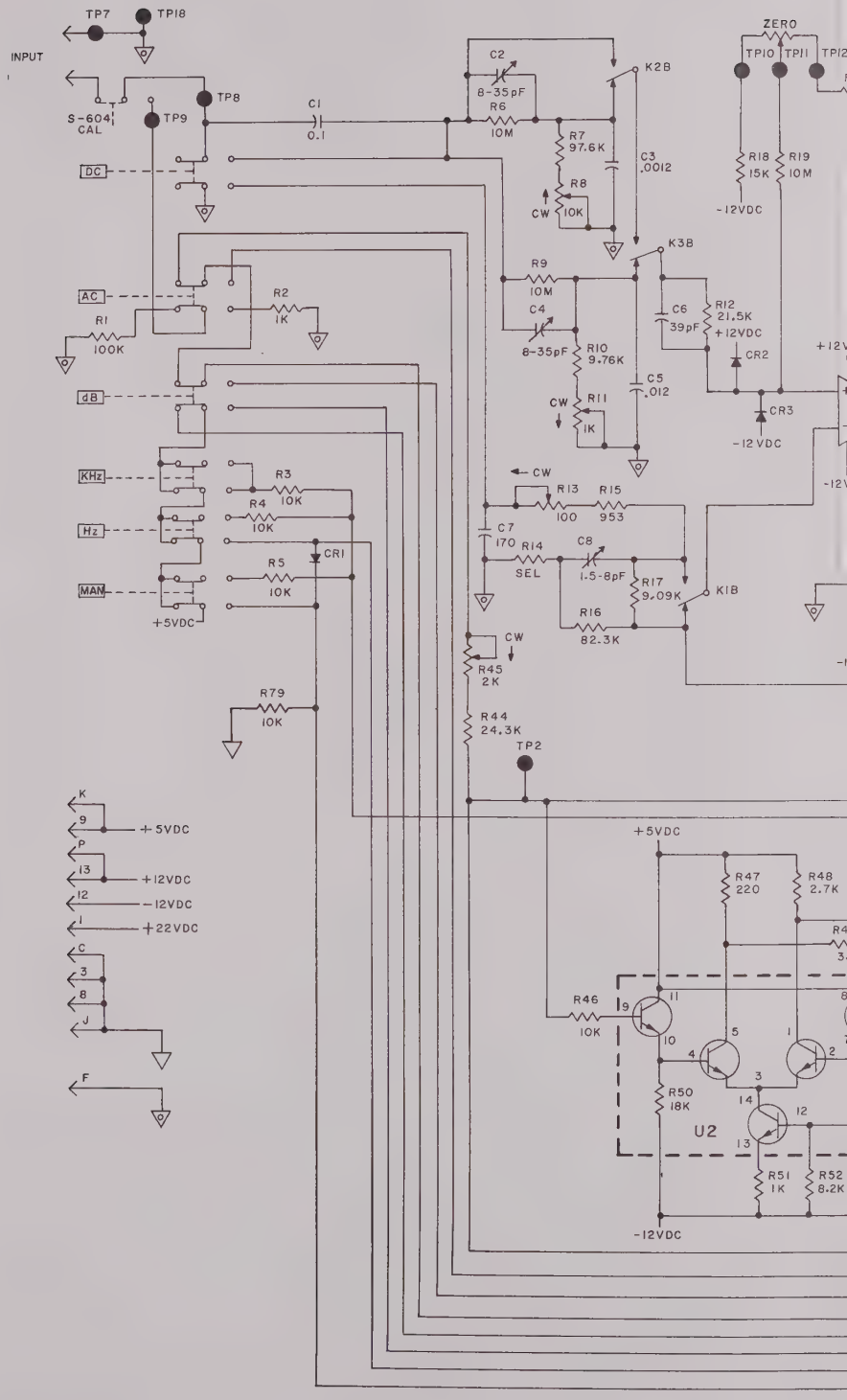
Figure 6-10. Model 2000R Bottom Plate Assembly

SECTION 7

SCHEMATIC DIAGRAMS

7.1 INTRODUCTION.

7.2 Figures 7-1 through 7-4 are the schematic diagrams for the Models 2000 and 2000R Multi-function Meter


TP7
TP18
INPUT
S-604 CAL
TP8
TP9
C1
0.1
C2
8-35pF
R6
10M
K2B
R7
97.6K
C3
.0012
R8
CW
10K
ZERO
TP10
TP11
TP12
R18
15K
R19
10M
-12VDC
K3B
R9
10M
C4
8-35pF
R10
9.76K
C5
.012
R11
1K
C6
39pF
R12
21.5K
+12VDC
CR2
CR3
-12VDC
DC
AC
R1
100K
R2
1K
dB
KHz
Hz
MAN
+5VDC
R3
10K
R4
10K
R5
10K
CR1
CW
R13
100
R15
953
C7
170
R14
SEL
C8
1.5-8pF
R17
9.09K
R16
82.3K
K1B
CW
R45
2K
R79
10K
R44
24.3K
TP2
K
9
+5VDC
P
13
+12VDC
12
-12VDC
1
+22VDC
C
3
8
J
F
+5VDC
R47
220
R48
2.7K
R46
10K
11
9
10
5
1
4
2
3
14
12
13
R50
18K
U2
R51
1K
R52
8.2K
-12VDC

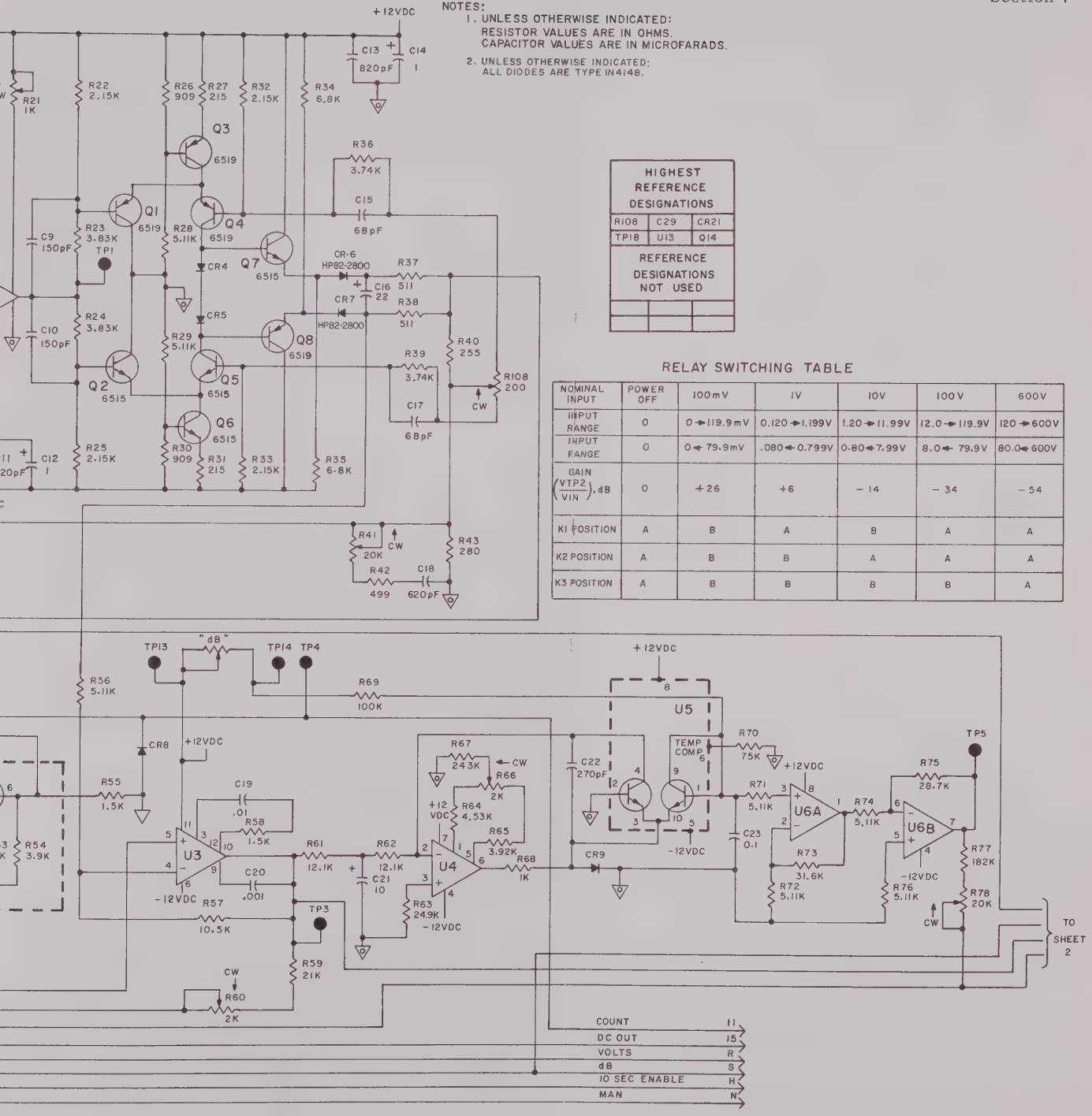
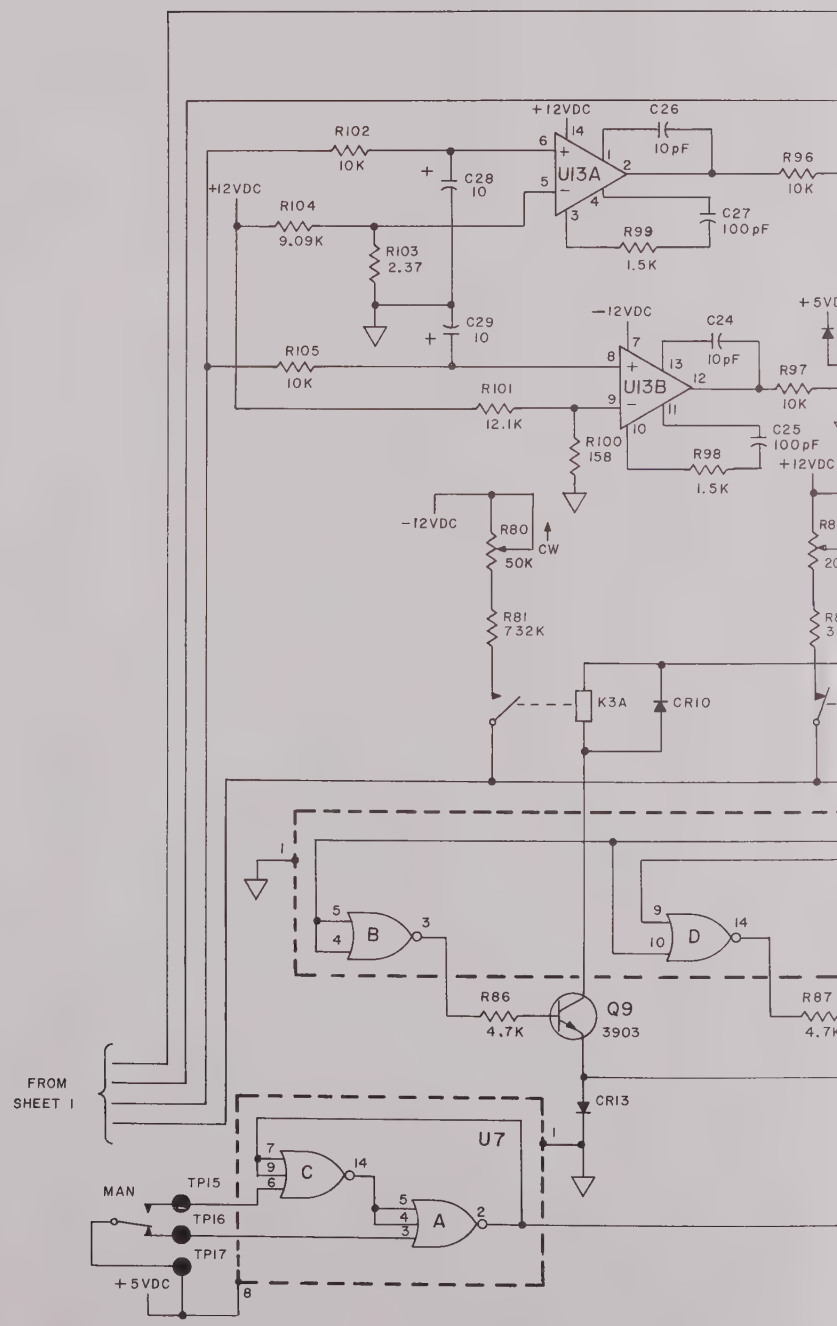


Figure 7-1. Input Section Schematic (Sheet 1 of 2)


+12VDC
R102
10K
C26
10pF
U13A
R96
10K
C28
10
+12VDC
R104
9.09K
R103
2.37
C27
100pF
R99
1.5K
C29
10
-12VDC
C24
10pF
R105
10K
U13B
R97
10K
R101
12.1K
R100
158
C25
100pF
R98
1.5K
+12VDC
-12VDC
R80
50K
CW
R81
732K
K3A
CR10
B
D
R86
4.7K
Q9
3903
R87
4.7K
FROM
SHEET 1
CR13
U7
C
A
MAN
TP15
TP16
TP17
+5VDC

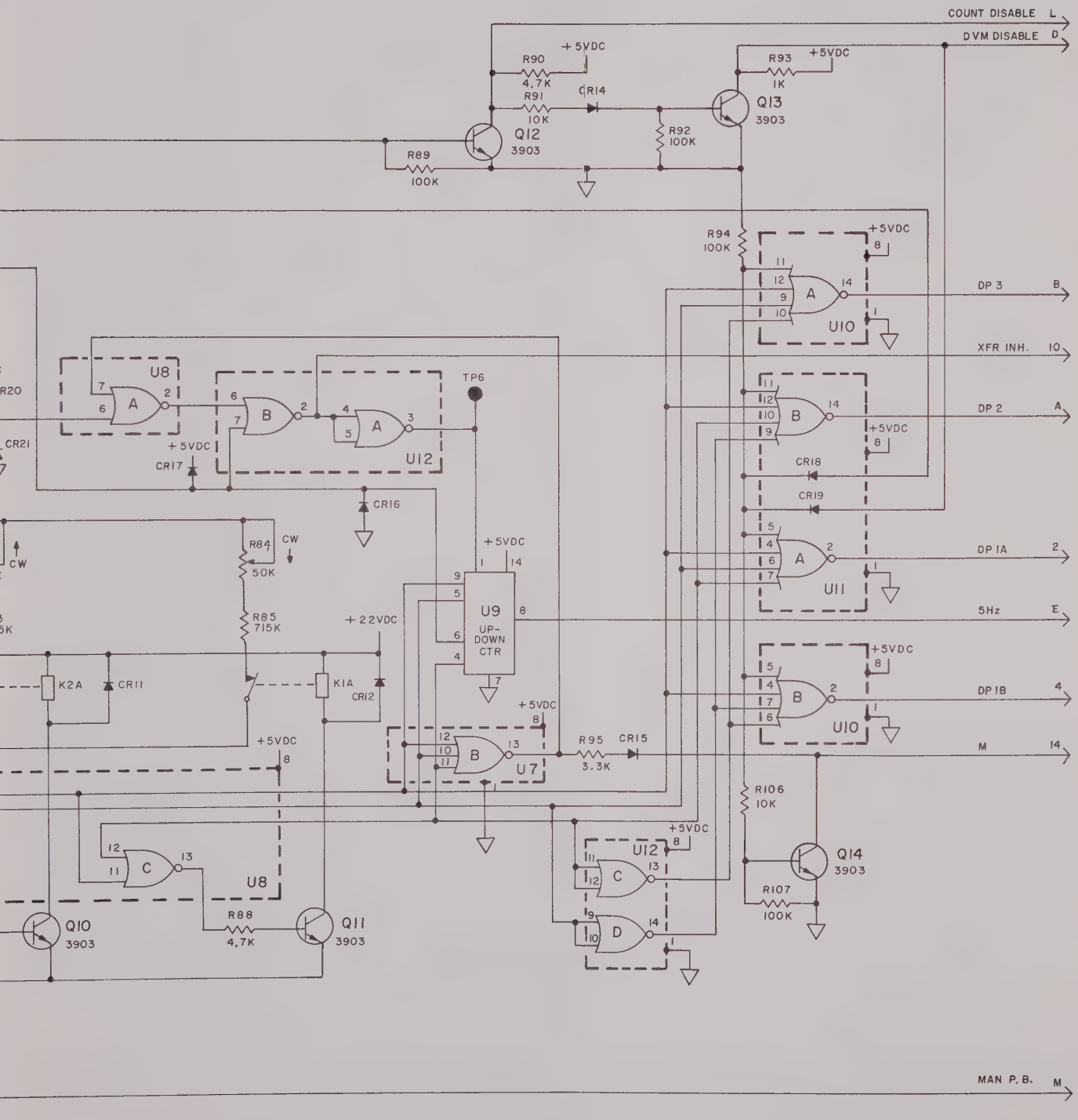
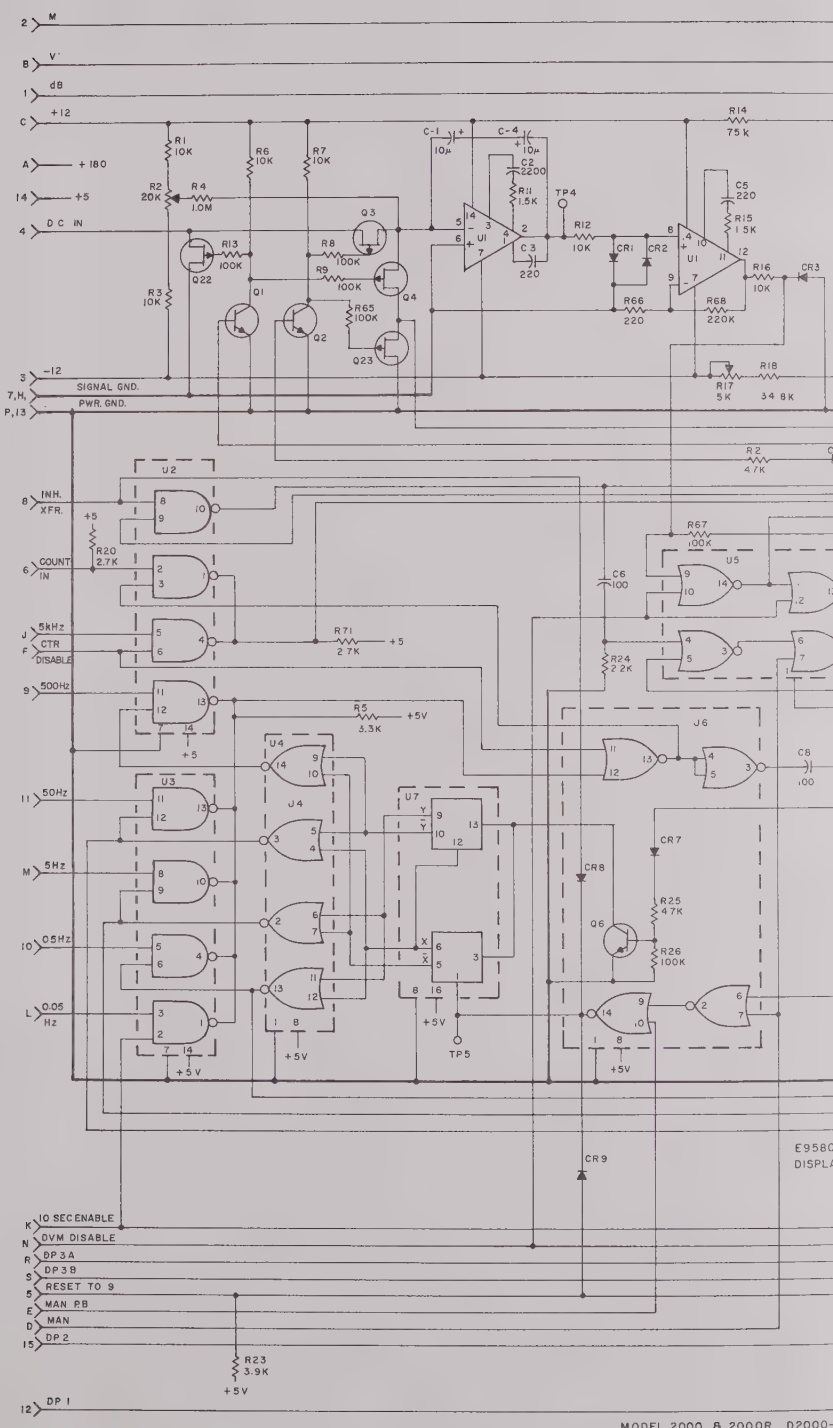


Figure 7-1. Input Section Schematic (Sheet 2 of 2)


2 M
B V
1 dB
C +12
A +180
14 +5
4 D C IN
3 -12
7,H, SIGNAL GND.
P,13 PWR. GND.
R1 10K
R2 20K
R4 1.0M
R6 10K
R7 10K
R3 10K
R13 100K
Q22
Q1
Q2
Q3
Q4
Q23
R8 100K
R9 100K
R65 100K
C-1 10µ
C-4 10µ
C2 2200
R11 1.5K
C 3 220
U1
TP4
R12 10K
CR1
CR2
R66 220
R14 75K
C5 220
R15 1.5K
R16 10K
CR3
R68 220K
R17 5K
R18 34.8K
R2 4.7K
8 INH. XFR.
6 COUNT IN
J 5kHz
F CTR DISABLE
9 500Hz
11 50Hz
M 5Hz
10 0.5Hz
L 0.05 Hz
R20 2.7K
R71 2.7K
R5 3.3K
+5
+5V
U2
U3
U4
U5
U6
U7
R67 100K
C6 100
R24 2.2K
C8 .00
CR7
CR8
CR9
Q6
R25 4.7K
R26 100K
TP5
E9580
DISPLA
K 10 SEC ENABLE
N DVM DISABLE
R DP 3A
S DP 3B
5 RESET TO 9
E MAN PB
D MAN
15 DP 2
12 DP 1
R23 3.9K
MODEL 2000 & 2000R D2000-

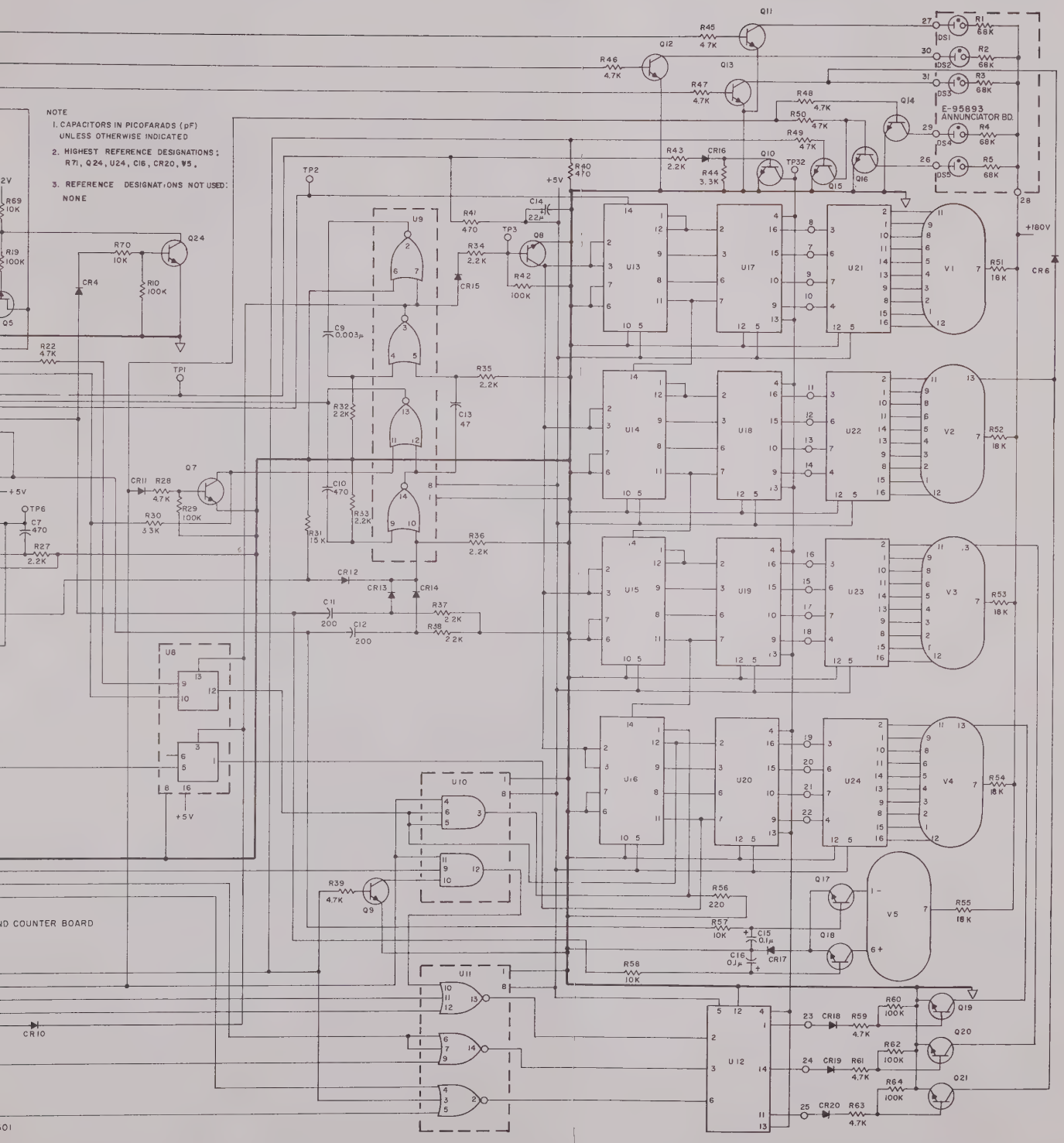
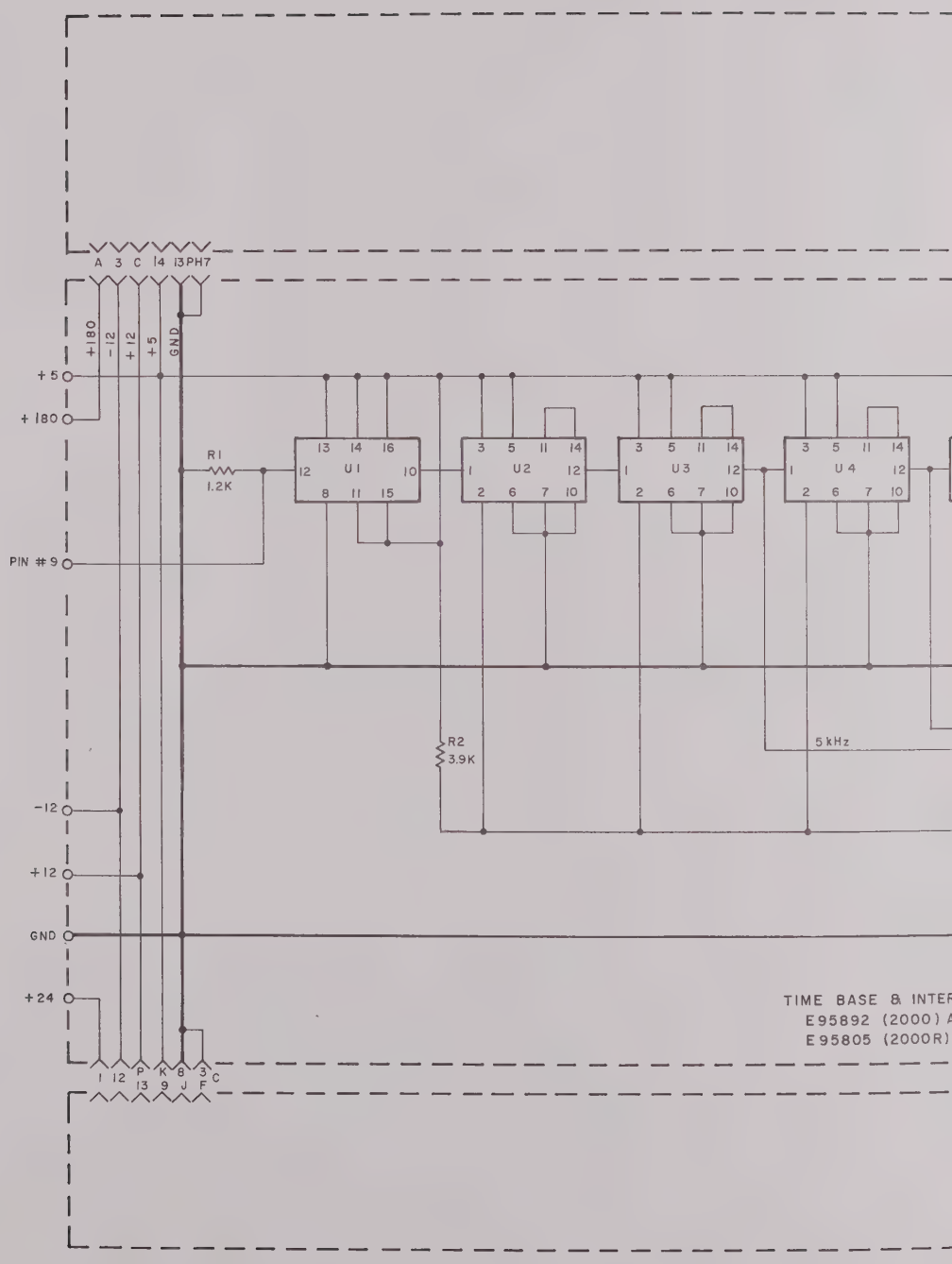


Figure 7-2. Counter and Display Schematic



NOTE:

1. RESISTORS RATED IN OHMS (Ω) K1000

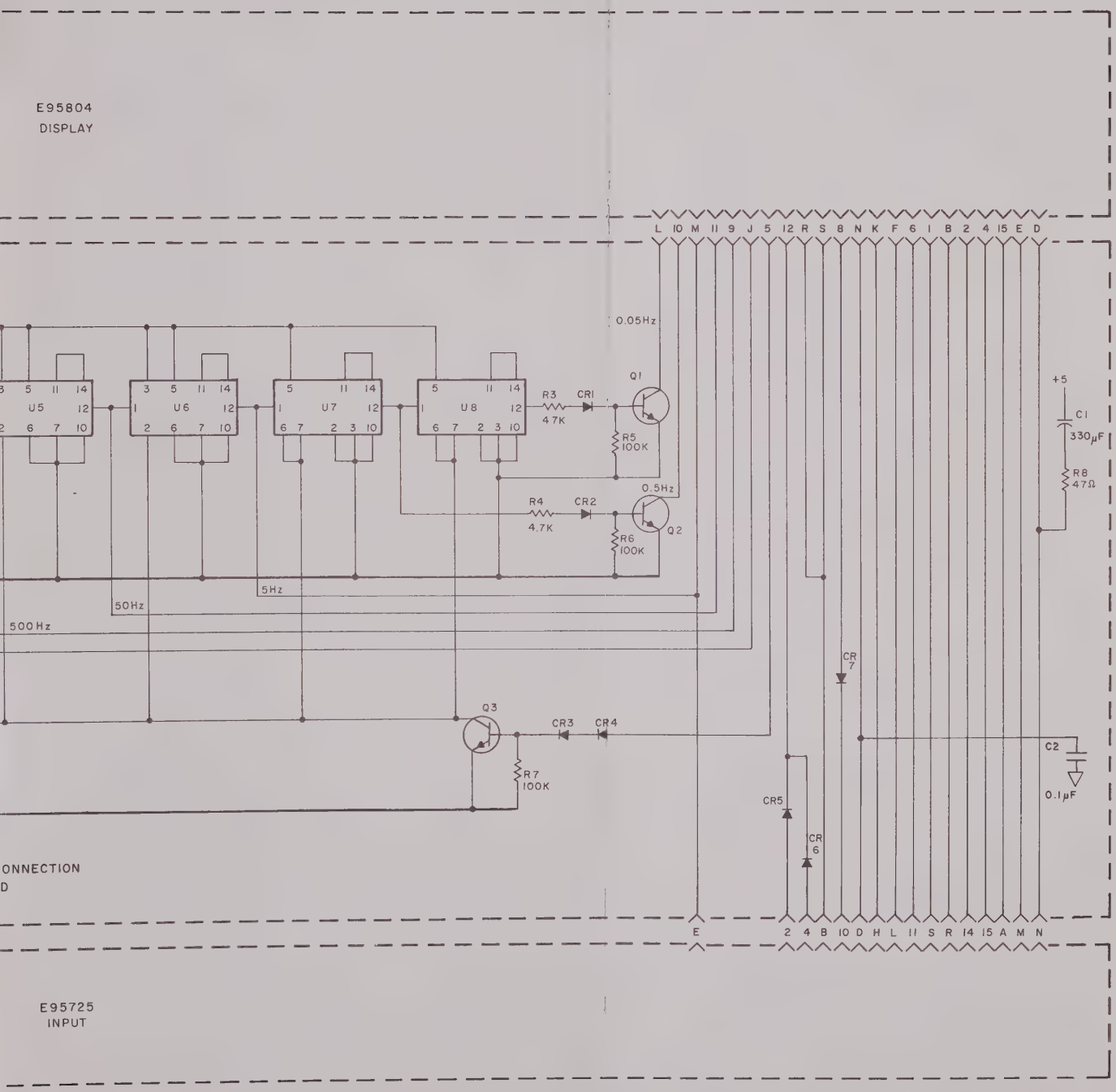
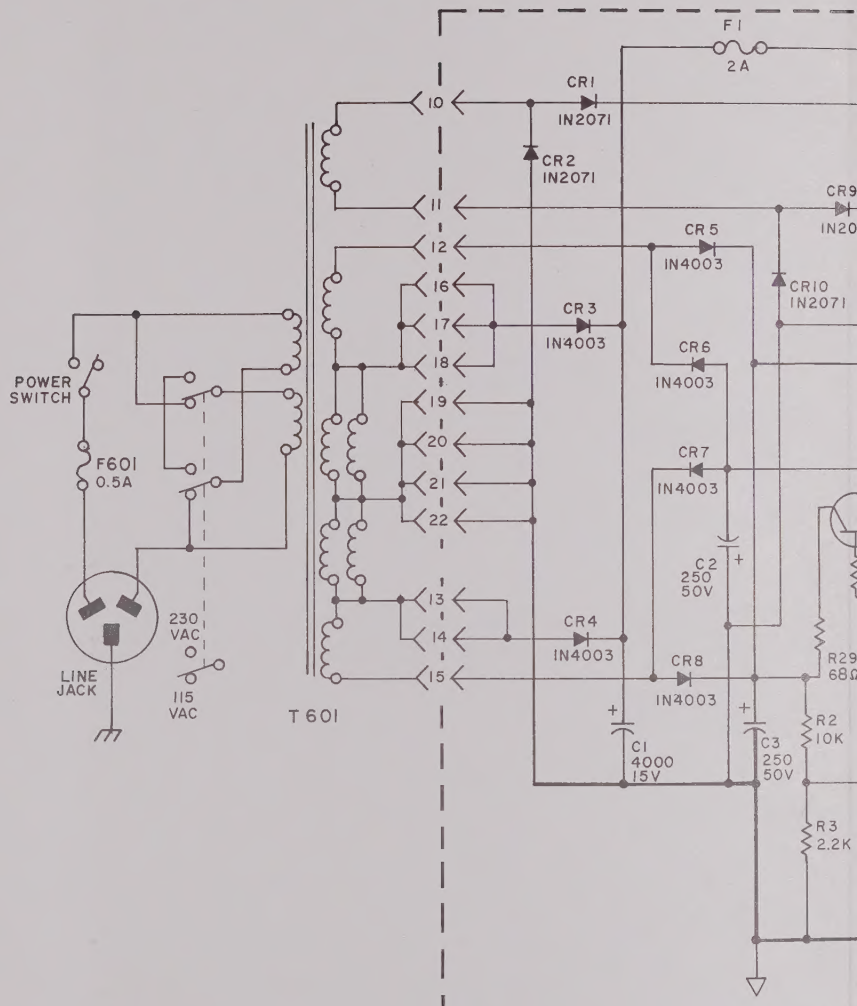


Figure 7-3. Time Base and Interconnection Schematic



NOTES:

ALL CONNECTIONS: P.C. FINGERS

ALL CAPACITORS RATED IN MICROFARADS (μF) UNLESS OTHERWISE INDICATED

ALL RESISTORS RATED IN OHMS (Ω) K=1000, M=1,000,000

HIGHEST REFERENCE DESIGNATIONS USED:
R30, C17, U2, Q6, X1, CR14, F1.

REF. DESIGNATIONS NOT USED:
NONE

POWER SUPPL
E95748

MODELS 200

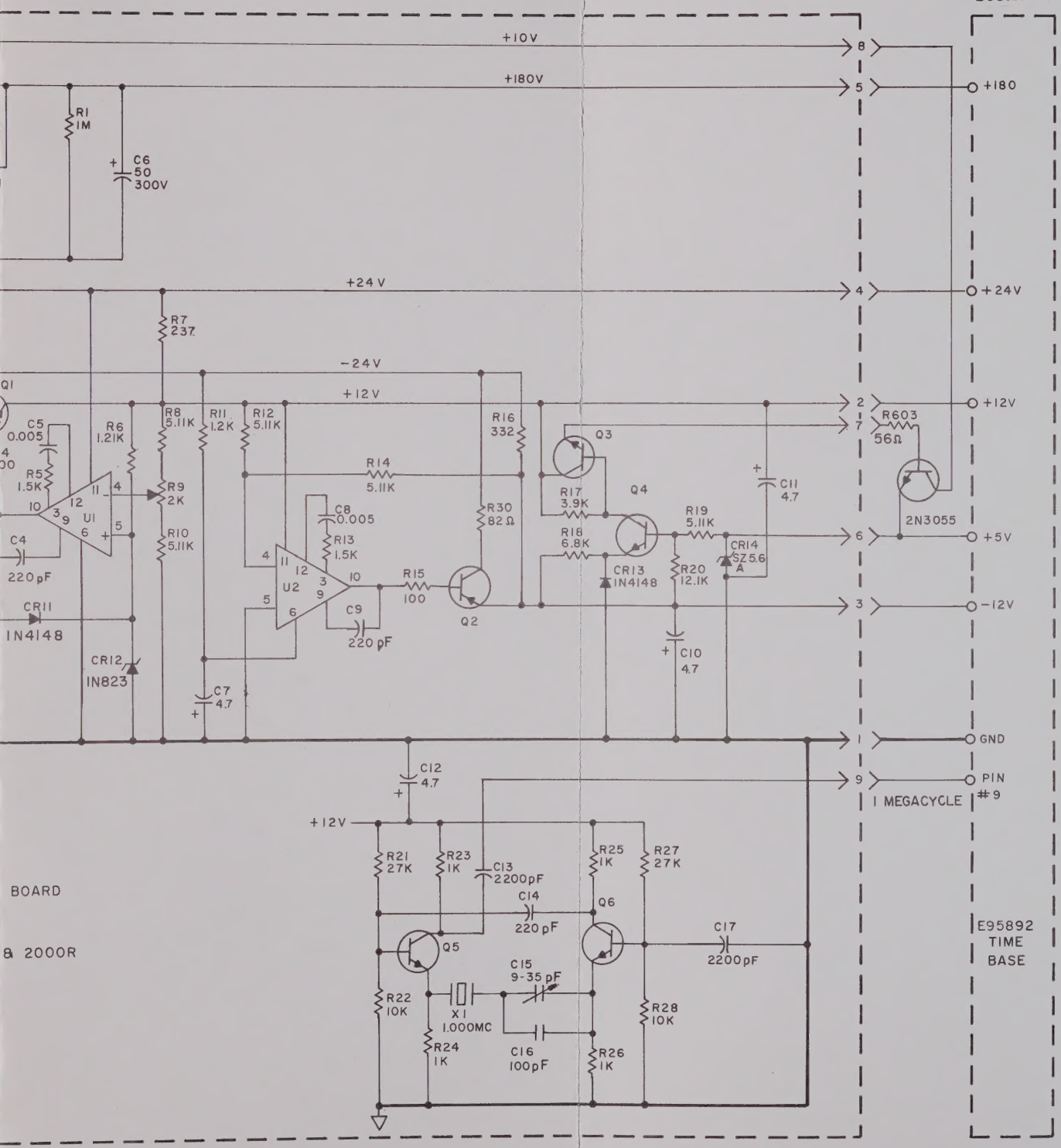


Figure 7-4. **Power Supply and Clock Schematic**